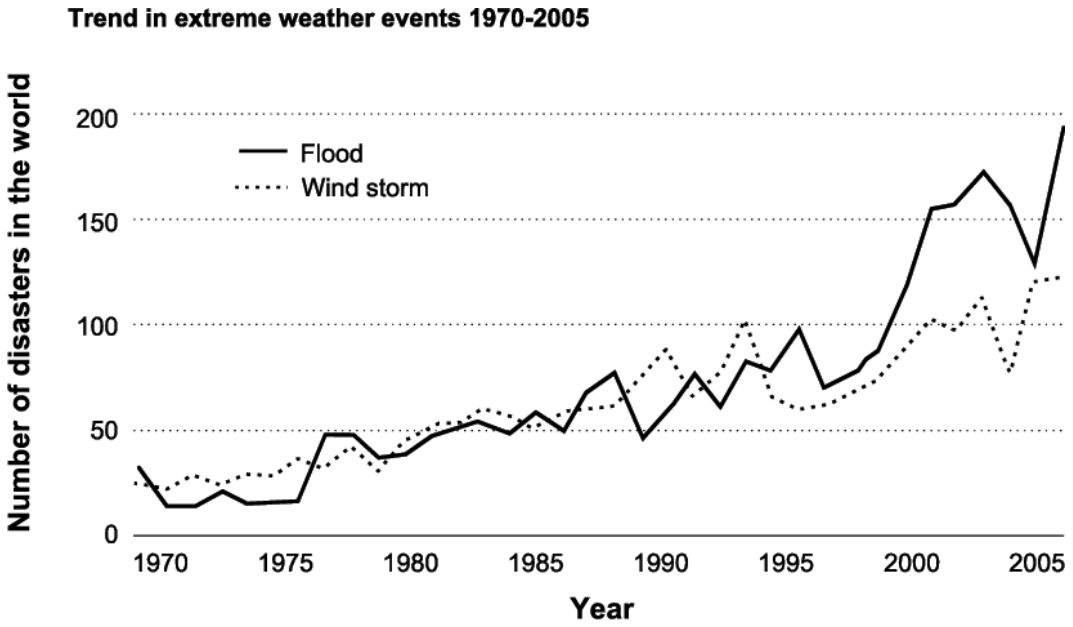
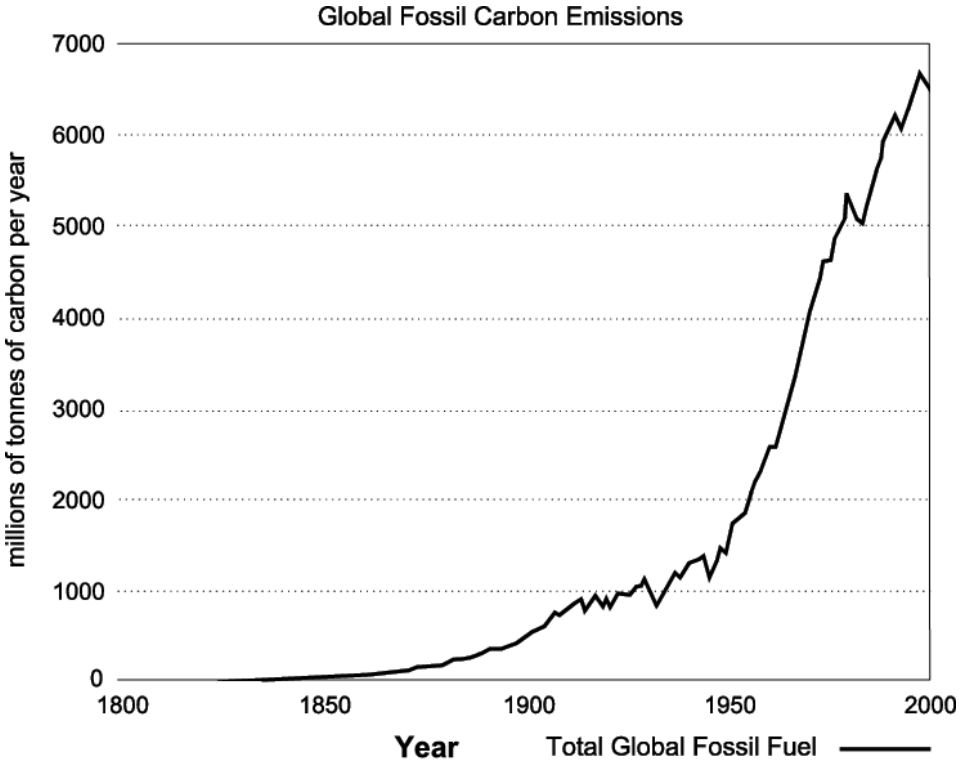
1(a). Extreme weather events make big news all over the world. Floods and storms have killed and injured many people around the world and caused massive damage to populated cities in recent years.



Fossil fuels are burned for energy in power stations and for transport. The graph shows how carbon emissions for the whole world have changed since 1800.



Scientists believe that there is a correlation between the numbers of different types of extreme weather events and the levels of global carbon emissions from burning fossil fuels.

Describe the correlation between the number of floods and storms and global carbon emissions.

Use data from the graphs in your answer.

[3]

(b). The graph for extreme weather events shows data from 1970 onwards. It is very difficult to gather data about the numbers of floods and storms in the past.

Since 1970, the number of floods and storms has increased by more than 100%, although the rise in global temperature over the same time is relatively small.

(i) Give reasons why it is difficult to gather reliable data about the number of floods and storms that have happened in the past.

---

[2]

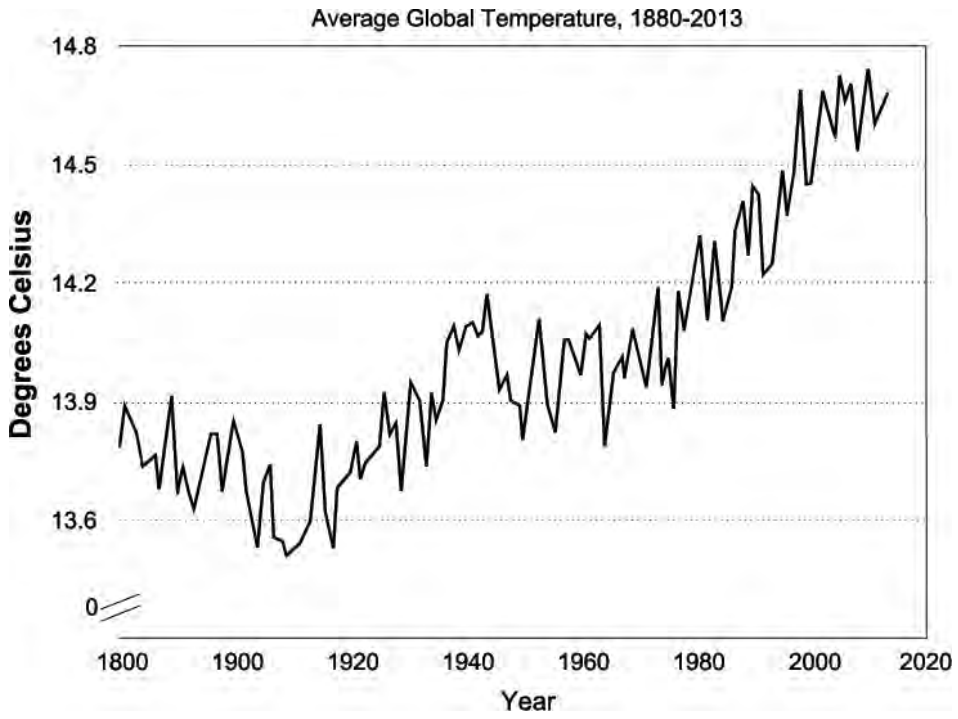
(ii) The table shows some data about the total number of floods and storms.

1971–1980	2001–2010
750	3000

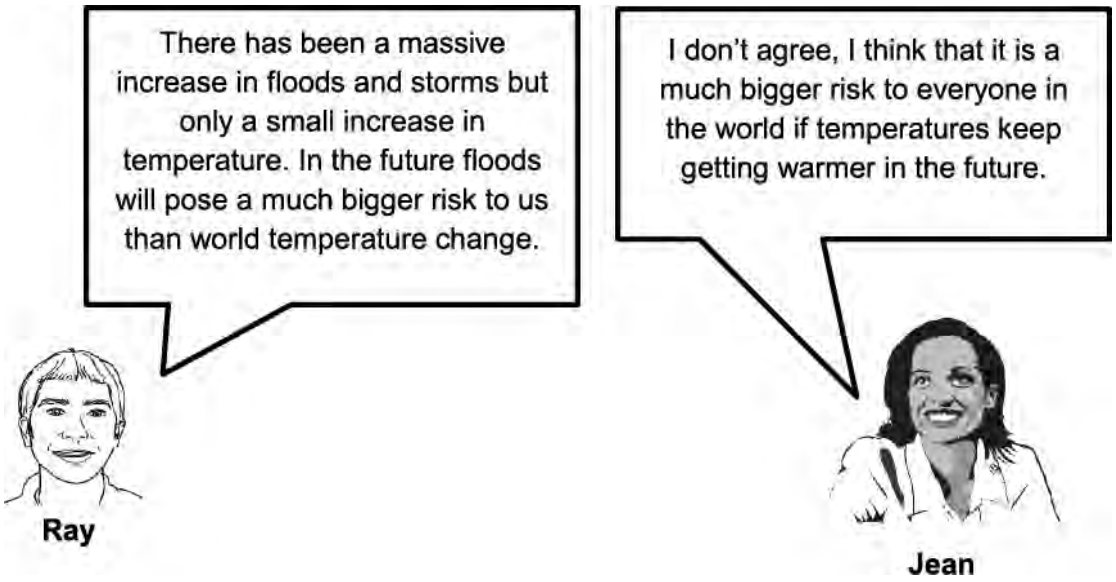
Use a calculation to show that the percentage increase in floods and storms is 400%.

[2]

(c). Scientists think that there is a correlation between carbon emissions and global temperatures. Floods and storms affect only some parts of the world and do not happen every day.



Ray and Jean talk about extreme weather and global temperature data.



Who do you think is right?

Explain your answer.

---

[4]

(d). Read the information about a new way to reduce the problems caused by carbon emissions.

Carbon storage schemes ‘capture’ carbon emissions from power stations before they are released into the air. One method stores the gas permanently on a very large scale in oil wells. The gas helps to increase the pressure on the oil so that more oil can be extracted from the well.

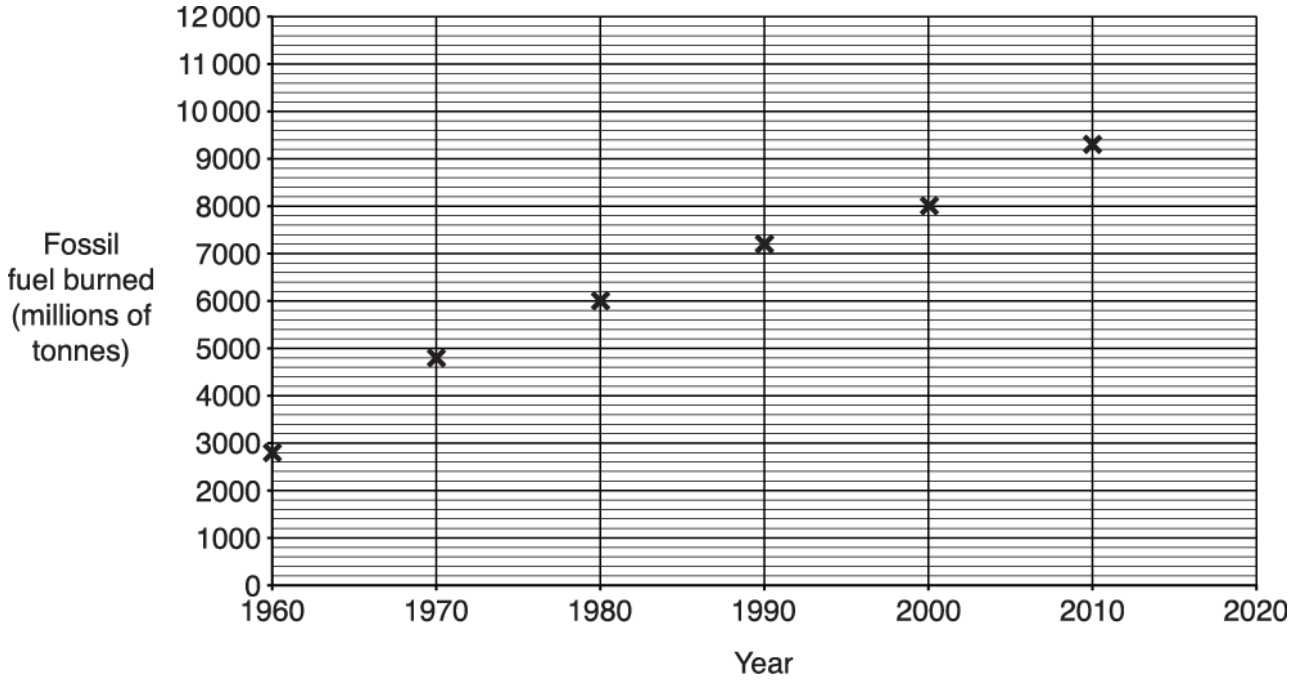
Now, scientists in Poland have developed a new method of making a carbon storage material from old CDs. Now that consumers download music and store it electronically, more and more CDs will be thrown away and can be recycled to make this new material. Scientists hope to be able to use the same methods to use other waste plastics.

Compare the benefits and drawbacks of using oil wells or old plastics for carbon emissions.

---

[3]

2(a). John looks at a graph that shows the amount of fossil fuels burned in the world between 1960 and 2010.



(i) John says that the amount of fossil fuels burned has increased by the same amount every ten years.

Is he correct?
Use data from the graph to justify your answer.

---

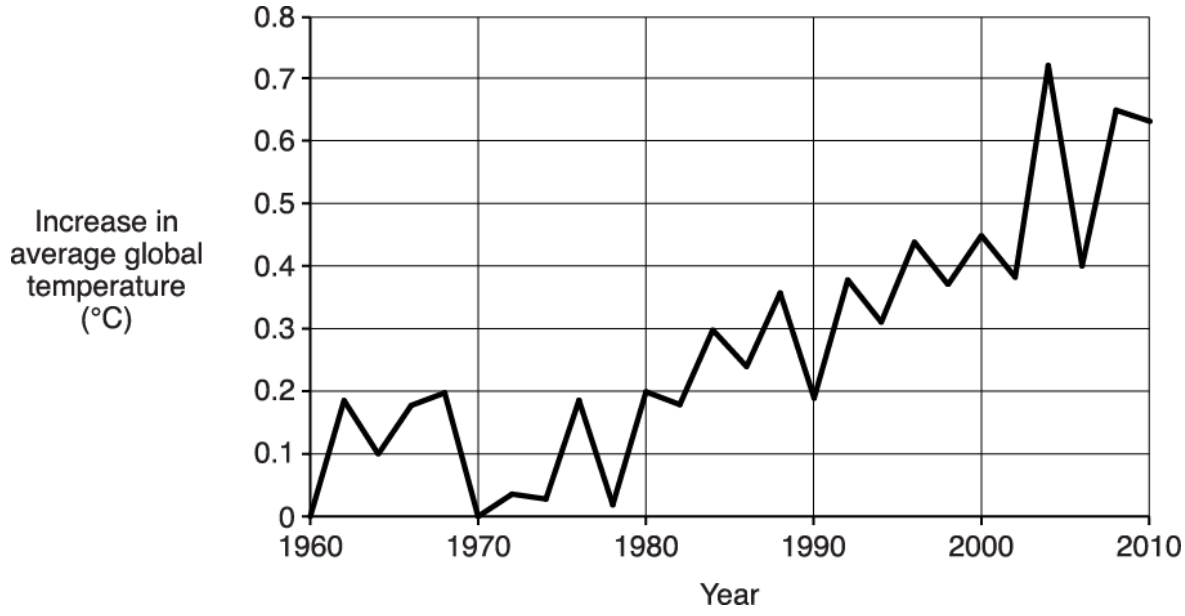
[2]

(ii) Estimate the amount of fossil fuels that will be burned in 2020.

_____ millions of tonnes

[1]

(b). John also looks at the changes in average global temperature over the same time.



(i) What does the graph show about changes in average global temperature?

_____

_____

_____

_____

_____ [2]

(ii) Complete these sentences about the **two** graphs.
Choose from the words in the list. You may use each word once, more than once or not at all.

cause	**correlation**	**decreased**
increased	**reaction**	**stayed the same**

From 1960–2010, the amount of fossil fuels burned has _____ and the average global temperature has _____.

This means there is a _____ between the amount of fossil fuels burned and the average global temperature.

[3]

3. Scientists measure the pollutants in the exhaust gases from 2 cars.

The cars are the same except for the fuel they use (petrol or diesel).

	Pollutant (grams per km travelled)	
	Nitrogen dioxide	Carbon particulates
Petrol car	6.0	none
Diesel car	9.0	0.5

Pollutants from cars build up in towns and can be harmful to human health.

Explain why each pollutant in the table is harmful and decide which car is better for use in towns.

The quality of written communication will be assessed in your answer.

[6]

4. Dom and Kate live in a town that has bus lanes.

Only buses can drive in bus lanes.

This means that at busy times buses travel faster than cars.

Buses and cars make carbon dioxide and other pollutants when they burn fuel.

Dom says there will be less air pollution as more people will travel by bus.

Kate says there will be more air pollution as a bus burns more fuel than a car.

Who is correct and why?

The quality of written communication will be assessed in your answer.

---

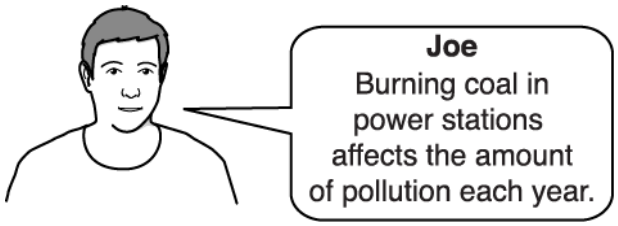
[6]

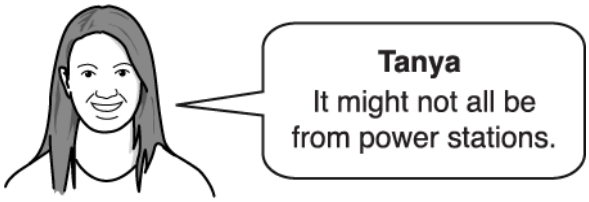
5(a). Beijing is a city in China where there are many coal-fired power stations.
Coal-fired power stations pollute the air with solid particles.

The table shows the amount of coal burned in power stations near Beijing.
It also shows the number of days in each year when solid particles were above the World Health Organisation (WHO) safe level.

	2008	2010	2012
Coal burned in power stations in thousands of tonnes per year	630	750	900
Days when pollution from solid particles was above the safe level	150	175	230

Joe and Tanya talk about the data in the table.

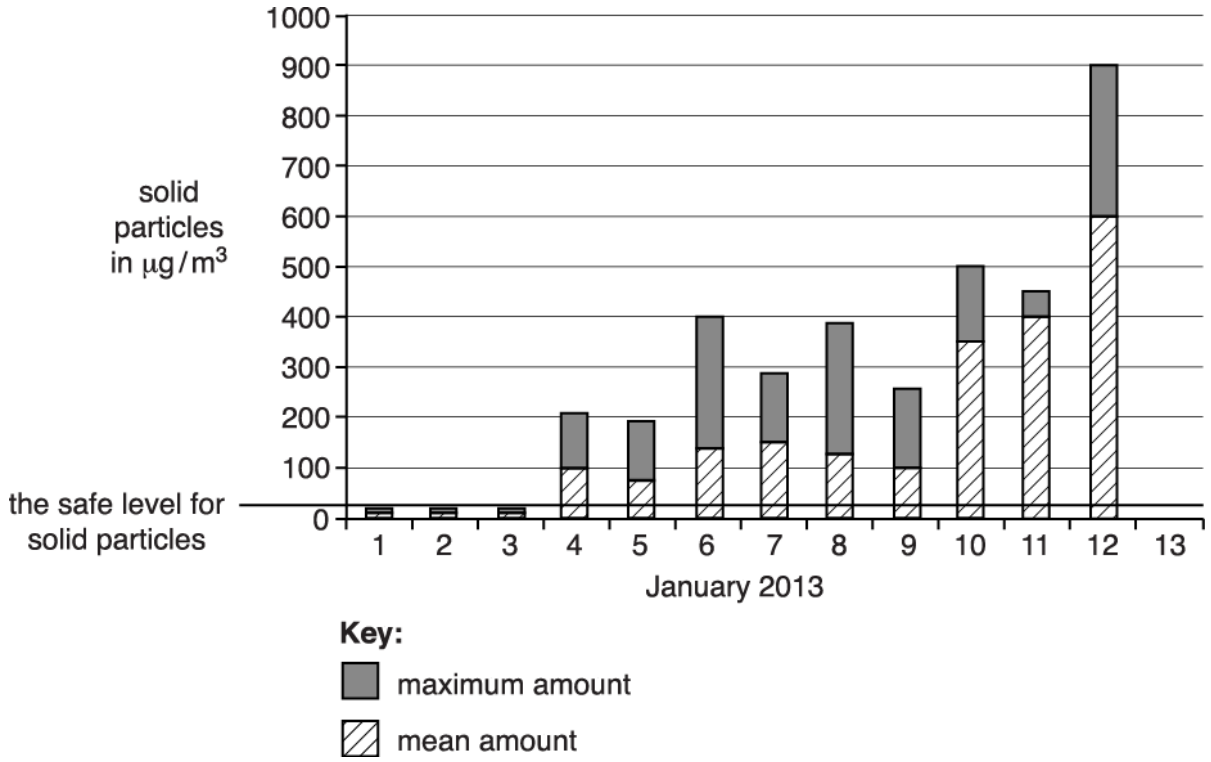




Both Joe and Tanya could be correct.
Explain why.

--- [3]

(b). The chart shows pollution from solid particles in Beijing for the first 12 days of January 2013.



(i) The safe level for solid particles is 25 µg/m^3.
This is shown on the chart.

Use the chart to find out if these statements are **true** or **false** over these 12 days.
Put ticks (✓) in the correct boxes.

	True	False
The **maximum** on 6th January was 400 µg/m^3.		
The **mean** on 9th January was 100 µg/m^3.		
The highest value on any day was 600 µg/m^3.		
There are only 5 days when the **mean** was **below** the safe level.		

[3]

(ii) The table shows solid particles in six samples of air taken on 13th January.

Solid particles in µg/m^3	150	200	250	500	400	300

What is the mean of this data?
Show your working.

_____ [1]

(iii) Use data in the table and your answer to **(ii)** to complete the chart in **(i)**.

Show **maximum** and **mean** solid particles for 13th January.

[2]

6(a). Millions of tonnes of hydrogen are made every year.

The hydrogen is usually made from methane.

The process starts with methane and steam, and makes hydrogen and carbon dioxide.

In this process 52 tonnes of methane and steam make 8 tonnes of hydrogen.

(i) The waste product of this reaction is carbon dioxide.
What mass of carbon dioxide is made from 52 tonnes of methane and steam?

answer _____ tonnes **[1]**

(ii) Why does this suggest that the process is not very green?

_____

_____

_____ **[2]**

(b). A new process for making hydrogen is by heating wood from trees.

Both processes for making hydrogen make carbon dioxide.

Suggest why this new process might be greener than the old one.

---

[2]

7. This table shows the average surface temperature increase of the Earth since 1952.

Year	Temperature Increase since 1952 (°C)
1952	0.00
1962	0.05
1972	0.00
1982	0.14
1992	0.22
2002	0.62
2012	0.62

(i) Describe how the Earth's temperature has increased since 1952.

---

[1]

(ii) Roughly how many times greater was the temperature increase in 2002 compared to the temperature increase in 1962?

Tick (✓) **one** box.

0.6 ☐

1.2 ☐

12 ☐

60 ☐

[1]

END OF QUESTION PAPER

Question			Answer/Indicative content	Marks	Guidance
1	a		floods increase / storms increase (over time) / correct use of figures from the graphs to illustrate a correlation for storms ✓ global carbon emissions increase (over time) / correct use of figures from the graphs to illustrate a correlation for carbon emissions ✓ increases follow a similar pattern ✓	3	Correct use of figures from the graphs to illustrate a correlation for storms.
	b	i	data not available / no data collected / can't go back ✓ data may be of lower quality / records not kept accurately / not systematic / different methods of collecting data / instrumentation make comparing data difficult ✓	2	
		ii	3000 ÷ 750 × 100 ✓ = 400 % ✓	2	
	c		<Jean because> global temperatures pose threat to more people / worldwide idea ✓ gives examples of effects of increase in global temperatures: more flooding, ice caps melting, climate change, crops failure / desertification ✓ floods give threat to local area idea / relatively few people ✓ number of floods and storms still (relatively) small / do not happen every day ✓	4	If decision is not given, then maximum (2) marks.

Question			Answer/Indicative content	Marks	Guidance
	d		gives advantage of either method: using CDs / old plastics uses waste / old oil wells are not useful ✓ (makes comparison): Oil wells are bigger scale / can store large amounts of carbon dioxide / not enough CDs idea / a lot of plastic will need to be stored somewhere idea ✓ (makes comparison): Using oil wells has other benefits / more oil is needed for fuels and making chemicals / helps to get (more) oil from oil well / oil is running out so using all reserves is beneficial ✓	3	
			Total	**14**	

Question			Answer/Indicative content	Marks	Guidance
2	a	i	'No' uses one 10 year period of correct data or identifies fluctuation in the size of increase in data (1) **and** uses a different 10 year period of correct data to compare and justify the answer (1)	2	'No' on its own is insufficient Correct data from graph that could be used: 1960-70 increase of 2000 (millions of) tons/bigger increase 1970-80 increase of 1200 (millions of) tons 1980-90 increase of 1200 (millions of) tons 1990-2000 increase of 800 (millions of) tons/smaller increase 2000-10 increase of 1300 (millions of) tons If 'yes' is given then check graph and **allow** maximum 1 mark if straight LOBF and 'yes' is justified **Examiner's Comments** This question required the calculation of the changes in 'fossil fuels burned' (millions of tonnes) for at least 2 of the sections of a 10 year period. The command words 'use the data' required such a calculation to enable both marks to be scored. A significant number of candidates didn't attempt the calculation, or incorrectly calculated these values over 2 ten year periods. The final evaluation of the data was generally well done, even when the values were incorrect.
		ii	Value between 10000 and 11000	1	**Examiner's Comments** Generally well answered from an extrapolation of the graph.
	b	i	Any two from: General trend is upward; Fluctuation occurs (line goes up and down); Reaches a maximum of (just over) 0.7 / reaches a maximum between 2000 and 2010	2	**Allow** positive correlation **Allow** calculation of increase in temperature for first marking point **Examiner's Comments** Most candidates could identify the general upward trend in the data. A significant number could also identify either the fluctuations in the data or the maximum point of the graph.

Question			Answer/Indicative content	Marks	Guidance
		ii	increased;(1) increased;(1) correlation;(1)	3	Examiner's Comments Generally well answered, with ‘increased’ being identified for the first space and ‘correlation’ identified for the last space. The only issue was the middle statement. ‘Reaction’ was a common incorrect response here.
			Total	8	

Question			Answer/Indicative content	Marks	Guidance
3			[Level 3] Chooses petrol car **AND** Give a reason why **both** pollutants are harmful **AND** Compares data for **both** of the pollutants Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) [Level 2] Chooses petrol car **AND** Give a reason why **both** pollutants are harmful **OR** Compares data for **both** of the pollutants **OR** Gives a reason why **one** pollutant is harmful **AND** compares data for **one** of the pollutants Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) [Level 1] Give a reason why one pollutant is harmful **OR** compares data for **one** of the pollutants. Quality of written communication impedes communication of the science at this level. (1 – 2 marks) [Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**This question is targeted at grades up to D** **Indicative scientific points may include:** Reasons for harm – nitrogen dioxide • Causes breathing problems • Possible links to asthma • Forms acid rain • Acid rain harms plants and animals Reasons for harm – carbon particulates • Causes breathing problems • Possible links to asthma • Makes things dirty Reasons for choosing petrol • diesel cars emit (3.0g/km) more nitrogen dioxide • diesel cars emit (0.5g/km) more carbon particulates • diesel emits more (of both) pollutants **Use the L1, L2, L3 annotations; do not use ticks.** **Examiner's Comments** Many candidates were able to correctly select the relevant data and explain why the petrol car was better. Quoting the data was not enough to score the full marks here and this was the area where candidates appeared to lack the skills needed to access the highest level on a frequent basis. The release of gases into the atmosphere was often confused with burning of the gases. Fewer candidates could articulate the effects of the pollutant gases on the atmosphere. Greenhouse gases and the ozone layer were often confused when used to attempt this question.
			Total	**6**	

Question			Answer/Indicative content	Marks	Guidance
4			[Level 3] Makes a choice and justifies this choice. Statements that discuss the amount of fuel burned **and** the amount of air pollution for cars and buses. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) [Level 2] Makes a choice and justifies this choice. Answer gives comparison between buses and cars in terms of air pollution **or** fuel burned. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) [Level 1] Simple statement about benefit of using a type of transport Quality of written communication impedes communication of the science at this level. (1 – 2 marks) [Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted at grades up to C Indicative scientific points may include: • choice of Dom, neither of both • fewer cars make less pollution / burn less fuel • if people travel on a bus rather than in cars then less fuel is burned overall / per person • one bus burns less fuel / makes less pollution than a number of cars • faster journey by bus linked to less fuel burned / less air pollution • cars stuck in traffic burn extra fuel / make more air pollution • air pollution increases as more fuel burned. Simple statements: • each bus carries more people than each car • if people travel on buses there will be fewer cars • journey time is longer in a car / shorter in a bus • some buses may not be full Only credit these statements if qualified or linked • more people travel by bus • bus burns more fuel • bus travels faster Use the L1, L2, L3 annotations in Scoris; do not use ticks. Examiner's Comments Many candidates struggled to follow the instructions set out by the question. Some failed to make a decision as to who was correct, Dom or Kate. Where a level 2 response was given it commonly included the link between the number of cars and the pollution given out by them in comparison to a bus. The link between

Question			Answer/Indicative content	Marks	Guidance
					volume of fuel burned and pollution given out or number of cars was less common. This limited the level achieved. Once candidates chose Dom the majority gave an argument for air pollution, or a fuel, rather than both. Many candidates expressed the idea that there would be more people on each bus which would reduce number of cars and then linked fewer cars to less pollution. Weaker candidates just repeated the information given in the question. Very few candidates omitted the question.
			Total	6	

<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>5</td><td>a</td><td></td><td>Data shows a correlation;

Increasing the amount of coal burned increases amount of pollution;

Example of another source e.g. transport / factories;</td><td>3</td><td>Allow does not show a causal link (1)

<u>Examiner's Comments</u>

Most candidates could give a different source of pollution to support Tanya’s ideas. The most common responses included ‘cars’ or ‘vehicles’. Fewer candidates were able to explain that as more coal was burned, the amount of pollution increased. Many simply repeated the ideas put forward by Joe. Very few candidates could go on to explain that the relationship between the amount of coal burned and pollution was a positive correlation.</td></tr>
<tr><td></td><td>b</td><td>i</td><td><table><tr><th>true</th><th>false</th></tr><tr><td>√</td><td></td></tr><tr><td>√</td><td></td></tr><tr><td></td><td>√</td></tr><tr><td></td><td>√</td></tr></table></td><td>3</td><td>All four correct = 3 marks
3 correct = 2 marks
2 correct = 1 mark

<u>Examiner's Comments</u>

The majority of candidates could identify the true and false statements in the table.The majority of candidates could identify the true and false statements in the table.</td></tr>
<tr><td></td><td></td><td>ii</td><td>Mean is calculated as 300;</td><td>1</td><td><u>Examiner's Comments</u>

This question proved difficult for some candidates. Where working out had been included in the response but the final answer was incorrect, there were errors in addition and the lack of division by six.</td></tr>
</table>

Question			Answer/Indicative content	Marks	Guidance
		iii	Mean is drawn at 300; (1) Maximum is drawn at 500; (1)	2	**Allow ecf** from (ii) Examiner's Comments A significant number of candidates omitted this question. This could have been because the question was not directly underneath the graph and so was simply missed. For the candidates that did attempt this question, the success rate was high. The 'error carried forward' from the calculation of the mean did not impede candidates unless they had simply added their values together. This meant that the scale in the graph could not accommodate their bars.
			Total	9	

Question			Answer/Indicative content	Marks	Guidance
6	a	i	44 [tonnes]	1	**Examiner's Comments** Answered correctly by many candidates; the principle of conservation of mass had been taught well in centres, and candidates recognised how to arrive at the correct response of 44 tonnes.
		ii	One from waste, and one from effect **Waste:** Most of reactants form a product which is not useful / a lot of waste / carbon dioxide (gas) is made / process has a low / poor atom economy (1) **Effect:** Product is a greenhouse gas / causes global warming / Product causes air / atmospheric pollution (1)	2	**Examiner's Comments** Many candidates achieved at least one mark here – usually for recognising that alot of waste was produced by the reaction, and many were able to state that carbon dioxide is a greenhouse gas. Some candidates did not achieve full marks because they stated that the reaction makes carbon dioxide (already given in the stem).
	b		Discusses both production and intake of CO_2: When trees are burned the CO_2 is released, however, this CO_2 was taken in by trees for photosynthesis = 2 marks Carbon neutral / attempts a description of carbon dioxide being given out being used by trees (1)	2	If no other mark is achieved then allow 1 mark for: wood is renewable / you can grow more trees ORA **Examiner's Comments** This question posed challenges for the majority of candidates. Two marks were rarely achieved. Despite the question stating that *both* processes produced carbon dioxide, candidates still used this as a response. This question required candidates to discuss both the intake and production of carbon dioxide; trees absorb carbon dioxide was sometimes given as a response, but candidates also needed to explain that this offsets the carbon dioxide produced in combustion.
			Total	**5**	

Question			Answer/Indicative content	Marks	Guidance
7		i	Irregular rise / generally up but sometimes falls / rises but now constant /AW ✓	1 (AO 3.1a)	The candidate must discuss the irregularity of the rise in some way Examiner's Comments Candidates are already told that the table shows temperature increase, so the important word in the command line is 'how'. Many candidates did appreciate that the increase was not regular, and so gained credit. A large minority of candidates answered a different question, "why", and so unfortunately gained no credit.
		ii	12 ✓	1 (AO 2.2)	Examiner's Comments This question discriminated well. The most popular incorrect response was 0.6.
			Total	2	