

1. These processes are used to make water safe to drink.
- chlorination
  - filtration
  - sedimentation

In what order are these processes done?

- A chlorination then filtration then sedimentation
- B filtration then sedimentation then chlorination
- C sedimentation then chlorination then filtration
- D filtration then chlorination then sedimentation

Your answer

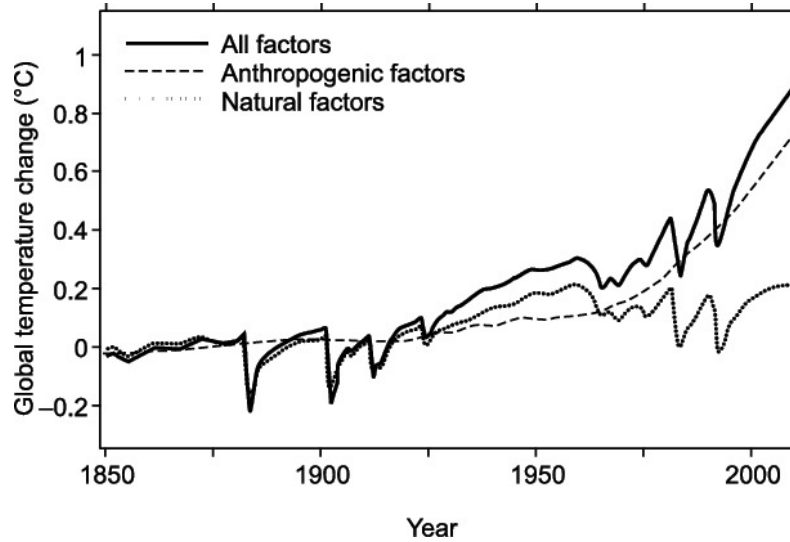
[1]

2(a). Gases such as methane and carbon dioxide absorb infrared radiation that is radiated by the Earth's surface. As a result, the Earth's surface is warmed. This is called the greenhouse effect.

Look at the graph.

It shows how global temperatures have changed as a result of

- all factors
- anthropogenic factors
- natural factors



Evaluate the evidence that anthropogenic factors are contributing significantly to global temperature change.

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[4]

(b). Global temperature change is one potential effect of increased carbon dioxide levels.

Describe **three** ways in which this effect may be reduced.

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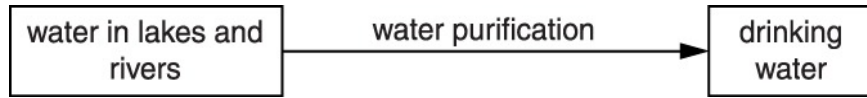
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[3]



3(a). Water from lakes and rivers must be purified before it can be used as drinking water.



There are **three** main stages in the purification of water.

Write about what happens at each stage.

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[3]

(b). Some samples of drinking water may contain traces of nitrate fertiliser.

Suggest why the water purification process does not remove nitrate fertiliser.

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[1]

(c). In some countries there is not enough water in lakes and rivers.

These countries distil sea water to make drinking water.

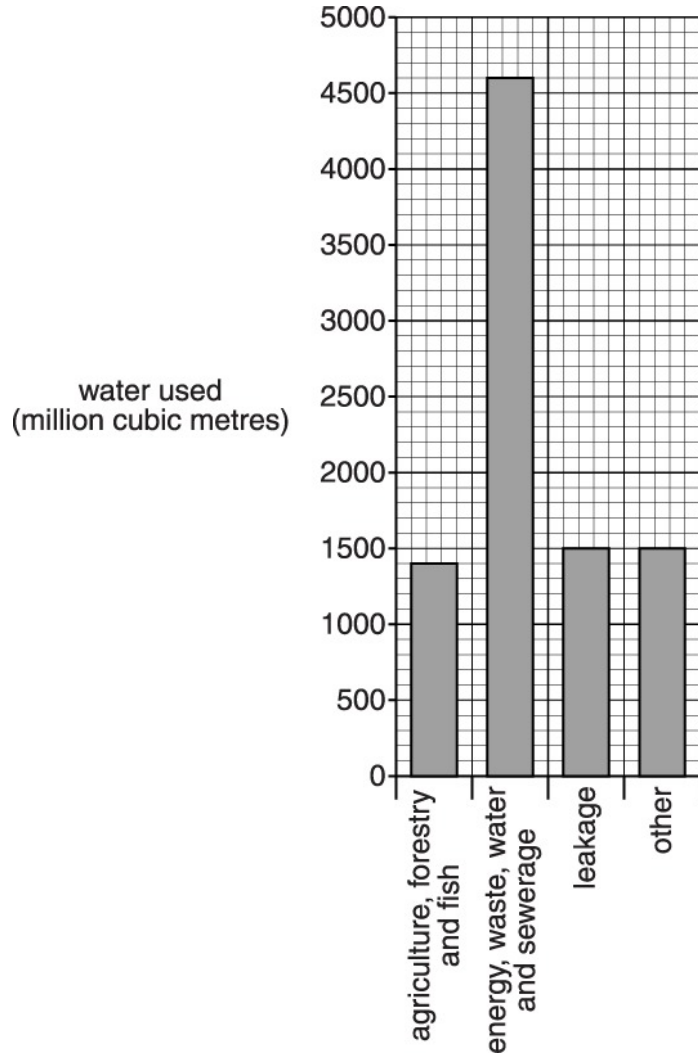
Explain one **disadvantage** of using distillation to make large quantities of drinking water.

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[1]

4. Look at the bar chart. It shows the use of water by different industries during one year.



The total volume of water used by industry in this year was 9000 million cubic metres.

What is the volume of water wasted by leakage? .....

Calculate the percentage of water used that was wasted by leakage.

answer ..... %

[2]

5. This question is about crude oil.

Crude oil is a fossil fuel.

Crude oil is often transported in large ships called oil tankers.



This could cause **environmental problems**.

Explain **two** of these environmental problems.

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[2]

6. This question is about the greenhouse effect and global warming.

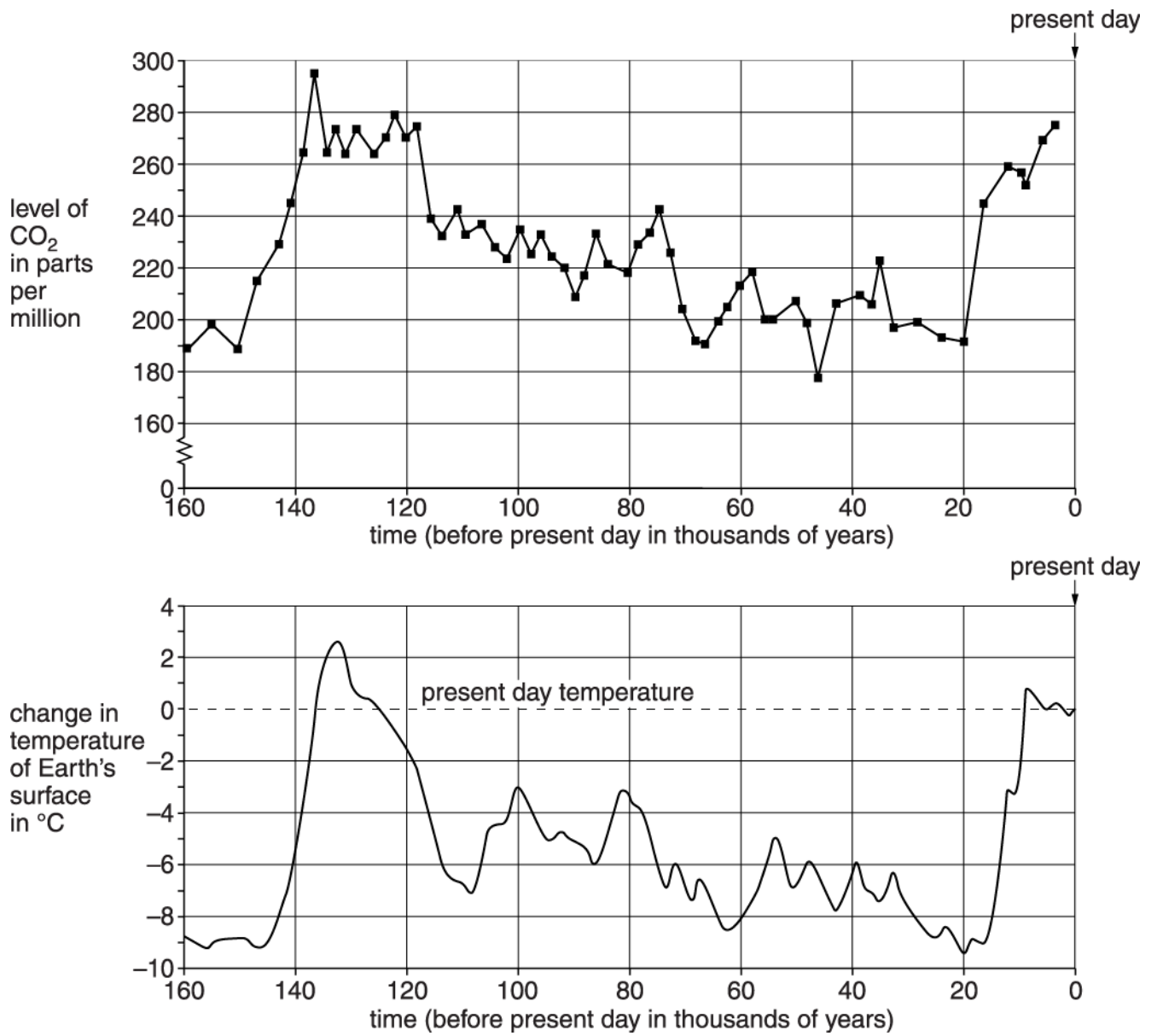
Some scientists say that an increase in global warming is part of a natural cycle.

Other scientists think that an increase in global warming will be disastrous for the world. They think that the surface temperature of the Earth is increasing and that this is because more fossil fuels are being burned.

Burning fossil fuels makes a lot of carbon dioxide.

Look at the graphs.

They show how the amount of carbon dioxide in the air and the temperature of the Earth have changed over the last 160 000 years.



(i) What is the **highest** level of carbon dioxide in the air during the last 160 000 years?

----- parts per million

[1]

(ii) Describe what has happened to the surface temperature of the Earth in the last 160 000 years.

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[2]



(iii) Is there a link between the surface temperature of the Earth and the level of carbon dioxide in the air?

Explain your answer. Use information from the graphs.

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----- [2]

7. Crude oil is a **non-renewable** fuel.

What is meant by a non-renewable fuel?

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----- [2]

8(a). The air may contain different pollutants.

Look at the table.

It shows the relative concentration of pollutants found in the air in two places.

Pollutant	Molecular formula	Relative concentration in the air	
		in a city centre	near a volcano
carbon monoxide	CO	0.3	0.01
hydrogen sulfide	H <sub>2</sub> S	0.01	210
nitrogen dioxide	NO <sub>2</sub>	1.5	0.1
sulfur dioxide	SO <sub>2</sub>	200	1500
trichlorofluoromethane	CFCI <sub>3</sub>	0.01	0.005

The concentration of air pollutants in a city centre is different from that near a volcano.

(i) There is a **higher** concentration of carbon monoxide in a city centre than near a volcano.

Suggest why.

----- [1]

(ii) Describe **two other** differences in the concentrations of air pollutants.

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----- [2]

(b). Some scientists think that volcanic eruptions cause acid rain.

What evidence is there in the table of data to support this idea?

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----- [2]

9. Look at the table. It shows information about gases which pollute the air.

Pollutant gas	Solubility in water	pH of solution	Effect on marble statues	Effect on steel	Effect on humans
A	very soluble	8	none	none	none
B	insoluble	not applicable	none	none	poisonous
C	very soluble	3	reacts slowly	increases rusting	causes coughing
D	very soluble	4	reacts slowly	increases rusting	causes coughing and photochemical smog

Karen thinks that pollutant gases A, C and D all cause acid rain.

Does the evidence support this?

Explain your answer.

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[3]

10. The air may contain different pollutants.

Look at the table.

It shows the relative concentration of pollutants found in the air in two places in the world.

Pollutant	Relative concentration in the air	
	in a city centre	near a volcano
carbon monoxide	0.3	0.01
hydrogen sulfide	0.01	210
oxides of nitrogen	1.5	0.1
sulfur dioxide	200	1500
trichlorofluoromethane	0.01	0.005

Some scientists think that volcanic eruptions cause acid rain.

What evidence is there in the table of data to support this idea?

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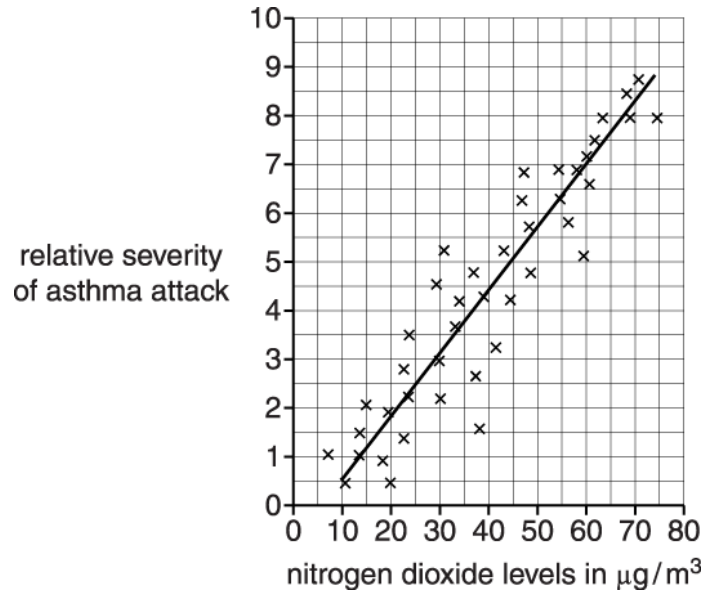
[2]

11. Nitrogen dioxide is a pollutant found in air.

Scientists think that there is a link between nitrogen dioxide levels and the severity of asthma attacks.

Look at the graph.

It shows data about the severity of asthma attacks in young men.



The data is for men aged between 20 and 40 who live in a city centre.

Nick thinks you can use the graph to draw a firm conclusion about nitrogen dioxide levels and the severity of all asthma attacks.

Phil thinks more evidence is needed.

Suggest who is correct. Explain your answer.

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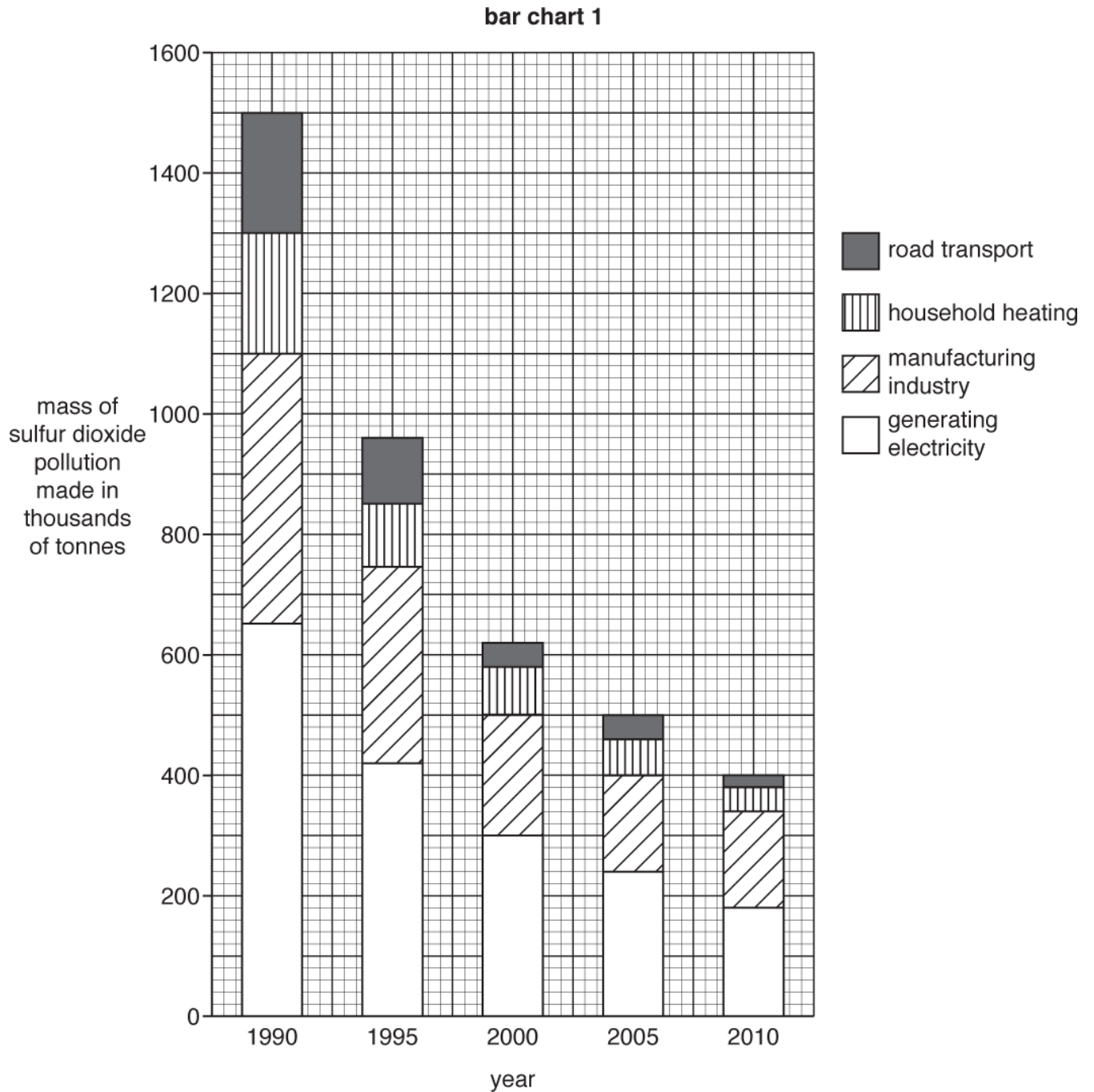
[1]

12(a) This question is about the atmospheric pollutants:

- sulfur dioxide,  $\text{SO}_2$
- oxides of nitrogen,  $\text{NO}_x$

Look at bar chart 1.

It shows the mass of **sulfur dioxide** pollution made in France in different ways between 1990 and 2010.



(i) What is the difference between the masses of sulfur dioxide pollution made by generating electricity between 1990 and 2010?

answer \_\_\_\_\_ thousand tonnes

[1]

(ii) The total mass of sulfur dioxide made between 1990 and 2010 has fallen.

Suggest possible reasons why.

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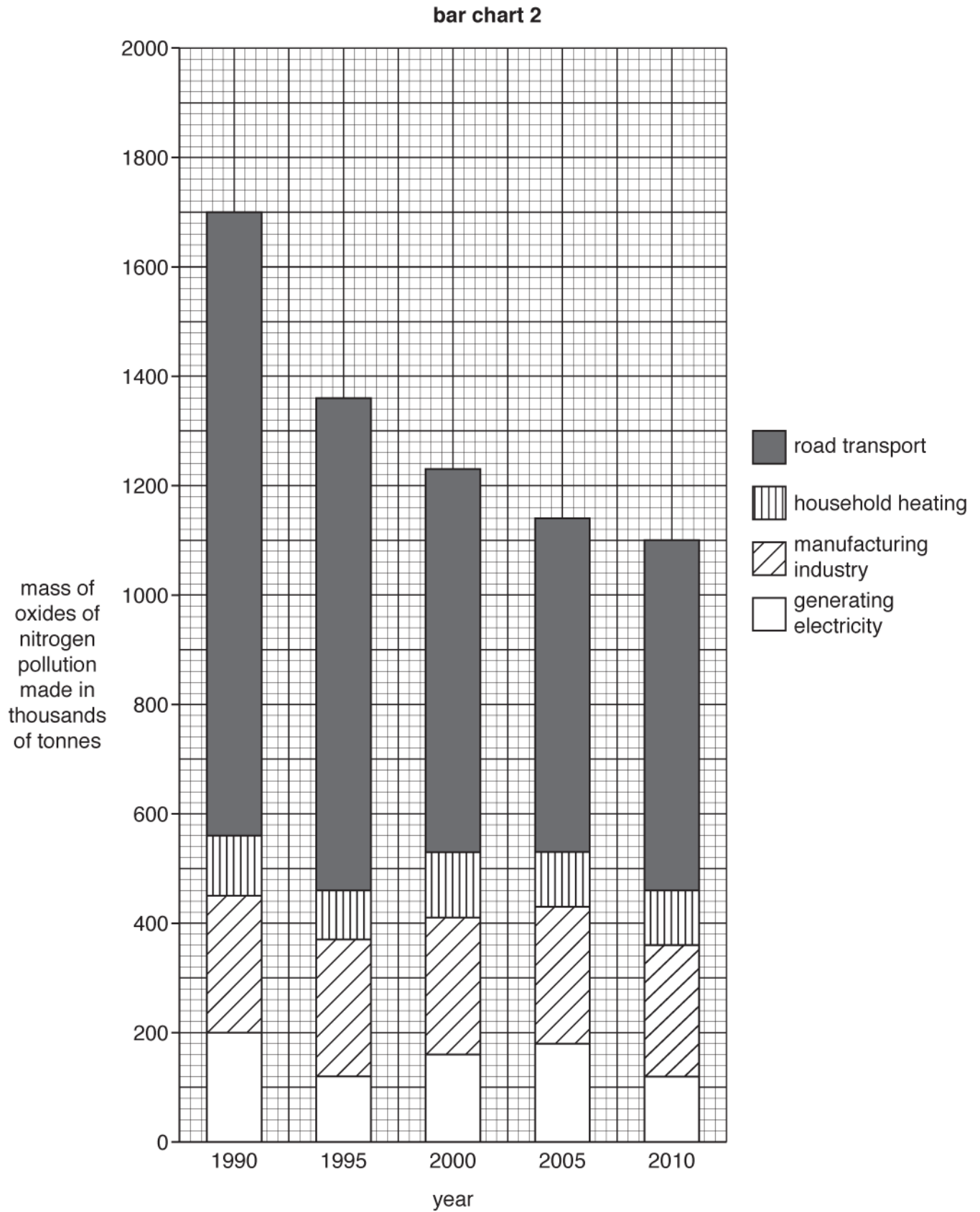
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[2]

(b). Look at bar chart 2.

It shows the mass of **oxides of nitrogen** pollution made in France in different ways between 1990 and 2010.





(i) Identify **three** trends about the mass of oxides of nitrogen pollution made from 1990 to 2010.

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**[3]**

(ii) The percentage of oxides of nitrogen pollution made by road transport in 2010 is 58.2%.

The percentage of oxides of nitrogen pollution made by household heating is 9.1%

Calculate the percentages made by manufacturing industry and by generating electricity in 2010.

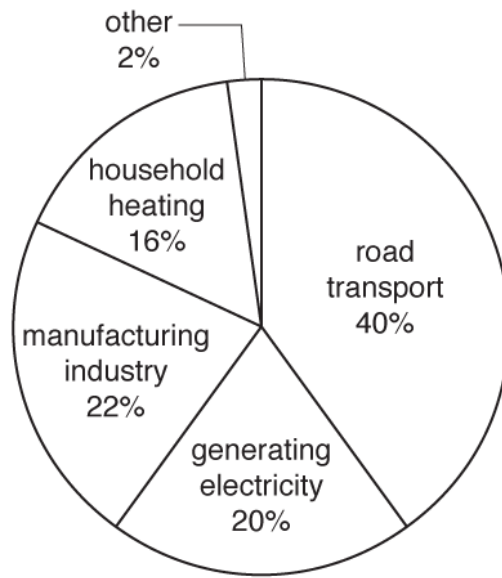
manufacturing industry \_\_\_\_\_ %

generating electricity \_\_\_\_\_ %

**[2]**

(c). Look at the pie chart.

It shows the percentages of oxides of nitrogen pollution made in different ways in the UK in 2010.



Use bar chart 2, your answers to part (b)(ii) and the pie chart to compare the production of oxides of nitrogen pollution in France and in the UK in 2010.

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[2]

13. Look at the table.

	Nitrogen	Oxygen	Carbon dioxide
A	21%	78%	0.04%
B	80%	15%	5%
C	70%	20%	10%
D	78%	21%	0.04%

Which row in the table shows the correct percentages of gases in the present day atmosphere?

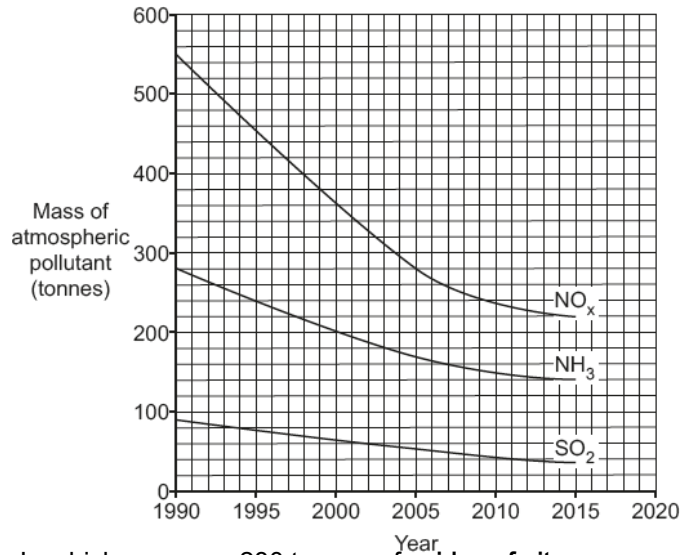
Your answer

[1]

14. The graph shows how the masses of three atmospheric pollutants have changed in one city since 1990.

The atmospheric pollutants are:

- Oxides of nitrogen,  $\text{NO}_x$
- Ammonia,  $\text{NH}_3$
- Sulfur dioxide,  $\text{SO}_2$



In which year was 280 tonnes of **oxides of nitrogen** present in the atmosphere?

- A 1990
- B 2000
- C 2005
- D 2010

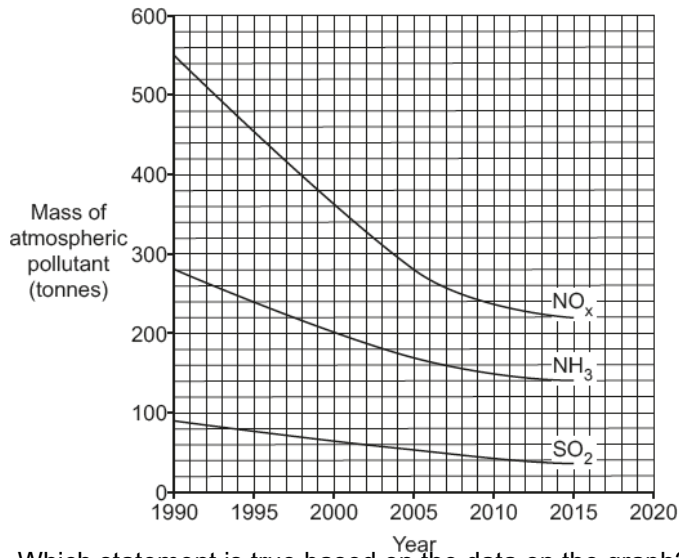
Your answer

[1]

15. The graph shows how the masses of three atmospheric pollutants have changed in one city since 1990.

The atmospheric pollutants are:

- Oxides of nitrogen,  $\text{NO}_x$
- Ammonia,  $\text{NH}_3$
- Sulfur dioxide,  $\text{SO}_2$



Which statement is true based on the data on the graph?

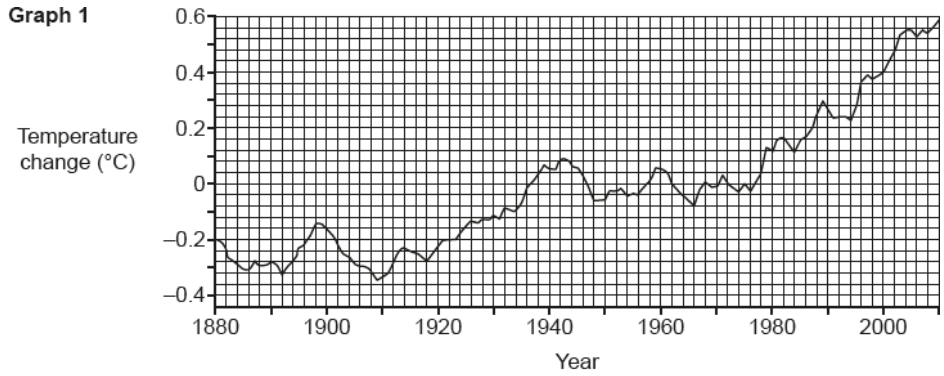
- A In 2015 the level of oxides of nitrogen was higher than the levels of sulfur dioxide or ammonia.
- B The levels of all three pollutants fell by the same amount between 1990 and 2015.
- C The level of ammonia fell the most between 1990 and 2015.
- D The level of sulfur dioxide decreased by more than half between 2000 and 2015.

Your answer

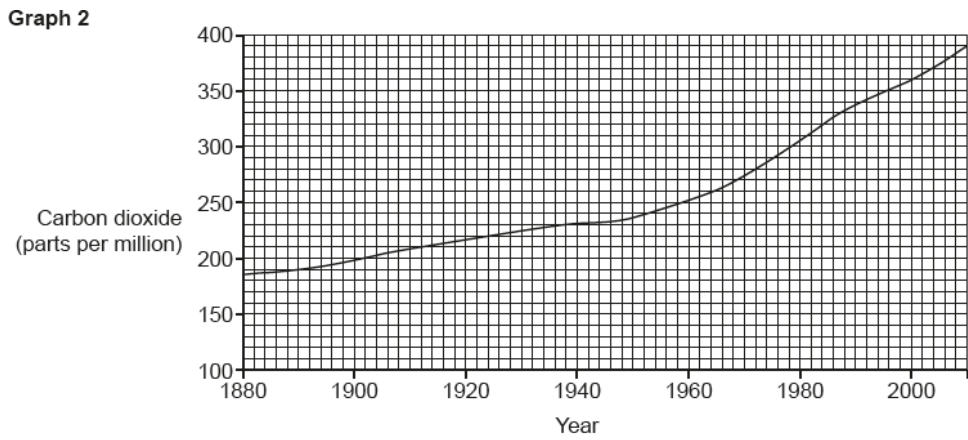
[1]

16(a) Look at the graphs.

Graph 1 shows how the Earth's temperature has changed between 1880 and 2010.



Graph 2 shows how the amount of carbon dioxide in the air has changed between 1880 and 2010.



In graph 2, what is the difference between the amount of carbon dioxide in the air between 1880 and 2000?

Answer = ..... parts per million [1]

(b). Some scientists believe that **graph 1 and graph 2** show that increased levels of carbon dioxide have increased the Earth's temperature.

Other scientists believe that it is just a natural cycle of change.

Quote data from the graphs which support **both** of these arguments.

Evidence to support increased temperature of Earth -----

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Evidence to support a natural cycle -----

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[2]

17. Look at the table.

	Nitrogen	Oxygen	Carbon dioxide	Argon
A	21%	78%	0.04%	0.1%
B	80%	15%	4.5%	0.5%
C	70%	20%	9%	1.0%
D	78%	21%	0.04%	0.9%

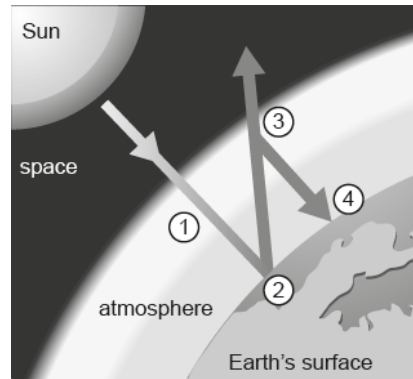
Which row in the table shows the percentages of gases in the present day atmosphere?

Your answer

[1]

18. Look at the diagram.

It shows four processes (1 – 4) which happen in the Earth’s atmosphere and on its surface.



Describe the four processes and how the greenhouse effect occurs.

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[4]

**END OF QUESTION PAPER**



### Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
1		B	1	
		<b>Total</b>	<b>1</b>	
2	a	idea that global temperatures have increased significantly (since about 1975) as anthropogenic factors have increased (1) idea that natural factors, and hence global temperatures, have not increased significantly (1)	2	
	b	<b>Any three from</b> reduce energy consumption/reduce burning of fossil fuels (1) use renewable energy sources (1) switch to hybrid vehicles/hydrogen fuel cell vehicles (1) buy energy efficient appliances (1) switch to energy efficient lighting (1) drive less / walk / use bus (1) choose foods with less air miles (1)	3	
		<b>Total</b>	<b>5</b>	
3	a	<b>filtration</b> to remove large / insoluble substances or objects (1)  <b>sedimentation</b> to let small particles / insoluble particles / suspended particles settle (1)  <b>chlorination</b> to kill microbes (1)	3	<b>allow</b> example of large object eg leaves / sticks / rocks / debris <b>ignore</b> just dirt <b>not</b> remove molecules / remove small particles, however if answer refers to filtration <b>by sand</b> then <b>allow</b> removes small particles  <b>not</b> large particles / molecules  <b>allow</b> add chlorine to kill bacteria or microorganisms <b>ignore</b> reference to germs  <b>allow</b> any order of the three processes  <b>Examiner's Comments</b>  Answers to this question were very confused. Many candidates knew the correct names of the processes but were unable to describe them correctly.

### Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
	b	nitrate is soluble in water / nitrate is dissolved in water (so not removed by filtration or sedimentation) (1)	1	<p><b>Examiner's Comments</b></p> <p>Many candidates thought that as nitrates had such small particles, they could not be removed. The better answers showed a realisation that nitrates were difficult to remove because they were soluble.</p>
	c	large amount of heat needed / large amount of energy needed (1)	1	<p><b>ignore</b> reference to cost unless qualified by reference to energy / heat</p> <p><b>Examiner's Comments</b></p> <p>There were many references to cost here but only the better answers explained why it was so costly.</p>
		<b>Total</b>	<b>5</b>	

### Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
4			water wastage through leakage = 1500 (1) percentage wastage = 16.7 (%) (1)	2	allow 1 500 000 000 allow ecf from wrong value of water leakage allow 16.6 (%) / 17 (%) (1) not 16 (%)  <b>Examiner's Comments</b>  Candidates mostly read the graph correctly and gave the leakage as 1500 cubic metres and then went on to calculate the percentage as 16.7%.
			<b>Total</b>	2	

### Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
5		<p><b>any two from</b></p> <p>(oil spills) damage to bird's feathers / kills birds / kills fish / kills animals / kills wildlife</p> <p>because <b>bird</b> is no longer buoyant or can't fly or feathers no longer waterproof</p> <p><b>or</b></p> <p>because poisons them / destroys their food</p> <p><b>or</b> damages fish gills</p> <p><b>or</b> idea of loss of income for fishermen (1)</p> <p>(oil spills) damages beaches / habitats</p> <p>because oil spills get washed up (1)</p> <p>idea that <b>detergents</b> used in clean up of oil spills are harmful to wildlife or damages wildlife (1)</p>	2	<p>2 examples with explanation for each = 2 marks</p> <p>1 or 2 examples with only one explanation = 1 mark</p> <p>2 examples no explanation = 1 mark</p> <p>e.g. oil spills damages beaches and wildlife (1)</p> <p>1 example no explanation = 0 marks</p> <p><b>allow</b> environmental problems related to emissions from engine of oil tanker e.g. carbon dioxide released (from tankers) because it causes climate change / global warming (1)</p> <p><b>ignore</b> just 'carbon dioxide or emissions or oil causes pollution'</p> <p><b>Examiner's Comments</b></p> <p>Few candidates could explain two environmental problems, most simply described two, which is low demand and did not answer the question.</p>
		<b>Total</b>	<b>2</b>	

### Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
6		i	292 – 298 / (ppm)	1	<p>allow any answer within this range</p> <p><b>Examiner's Comments</b></p> <p>Most candidates were able to give the correct value for carbon dioxide from the graph.</p>
		ii	<p><b>any two from:</b></p> <p>idea that rise at <b>start</b> / between 140 (000) and 130 (000) (1)</p> <p>idea of overall fall in the <b>middle</b> / 130 (000) years and 20 (000) years (1)</p> <p>gradual increase during last 20 (000) years / at the <b>end</b> (1)</p>	2	<p>They must make some reference to a specific section of the graph but describing the whole pattern scores 1 if no other mark scored</p> <p>e.g. it goes up then down then up (1)</p> <p>but e.g. it goes up then down (0)</p> <p><b>Examiner's Comments</b></p> <p>Few candidates correctly described the changes shown in the graph. Whilst one mark was given for an answer of went up, went down and then went up again, a more detailed answer in terms of the dates on the graph was needed for full marks. Candidates generally identified the link in that the carbon dioxide in the air and the temperature of the Earth went up together. More detail was needed for full marks. The most common response for the second mark was that the graphs followed the same pattern.</p>

### Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		iii	<p><b>either</b> as carbon dioxide levels increase so does the Earth's temperature / ora (1)</p> <p>idea that peaks broadly coincide (1)</p> <p><b>or</b></p> <p>no direct link between Earth's temperature and carbon dioxide levels (1)</p> <p>idea that peaks do not coincide exactly (1)</p>	2	<p>no mark for yes or no on its own <b>allow</b> correct use of data from the graphs e.g. both graphs have their highest peaks at about 135 (thousands of years before present day) <b>allow</b> as carbon dioxide levels increase so does the change in the Earth's temperature / ora</p> <p><b>allow</b> graphs follow a similar pattern / graphs have similar fluctuations</p> <p><b>allow</b> no exact match between surface temperature but the peaks or troughs broadly coincide (2)</p> <p><b>allow</b> other gases contribute towards global warming</p> <p><b>Examiner's Comments</b></p> <p>Candidates usually scored 1 mark for the idea that a small population produced a large amount of carbon dioxide, but some lacked the language skills necessary to explain fully.</p>
			<b>Total</b>	<b>5</b>	
7			<p>takes a long time to form (1)</p> <p>are used up faster than they are formed or cannot be made again or finite (1)</p>	2	<p><b>allow</b> takes (many) years to form or thousands or millions of years to form (1) <b>ignore</b> takes hundreds of years to form</p> <p><b>allow</b> once it's gone, it's gone / can't be replaced / will run out (1)</p> <p><b>ignore</b> cannot be used again <b>ignore</b> cannot be recycled</p> <p><b>Examiner's Comments</b></p> <p>Many candidates struggle with the concept of a non-renewable fuel. The most common answer is to incorrectly state that it cannot be used again.</p>
			<b>Total</b>	<b>2</b>	

### Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
8	a	i	(major source of carbon monoxide is from) cars or motor vehicles (1)	1	<p><b>allow</b> factories  <b>allow</b> there are no cars or motor vehicles near volcanoes  <b>allow</b> burning of fossil fuels</p> <p><b>allow</b> volcanoes do not give out carbon monoxide</p> <p><b>Examiner's Comments</b></p> <p>Many knew that cars and factories produced CO, but a large number said that there were more people or more pollution in the city centre which did not gain credit.</p>
		ii	<p><b>any two from:</b></p> <p>less hydrogen sulfide in city centre (1)  less sulfur dioxide in city centre (1)  more CFCs in city centre (1)  more nitrogen dioxide in city centre (1)</p>	2	<p><b>allow</b> ora with clear reference to volcano eg more hydrogen sulfide near volcano  <b>ignore</b> references to carbon monoxide</p> <p><b>Examiner's Comments</b></p> <p>Frequently candidates did not make comparisons and just quoted the figures given in the table.</p>
	b		<p>sulfur dioxide (causes acid rain) (1)</p> <p><b>but</b></p> <p>(idea of) more sulfur dioxide near volcano / ORA (2)</p>	2	<p><b>not</b> if more than one gas named e.g. sulfur dioxide and hydrogen sulfide (0)</p> <p><b>for second marking point there needs to be a clear comparison e.g.</b>  near a volcano it is 1500 and in city it is <b>only</b> 200 (1)</p> <p><b>Examiner's Comments</b></p> <p>Most candidates mentioned sulfur dioxide, some hydrogen sulfide, and a few candidates had difficulty clearly expressing the comparison.</p>
			<b>Total</b>	<b>5</b>	

### Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
9		<p>No (no mark)</p> <p>idea that only C and / or D have acidic pH values / idea that A has alkaline pH value (1)</p> <p>C and / or D attack marble or A does not attack marble (1)</p> <p>C and / or D increase rusting or A does not increase rusting (1)</p>	3	<p><b>ignore</b> yes, but continue marking</p> <p><b>allow</b> idea that C and / or D have low pH or A has high pH (1)</p> <p><b>allow</b> C and / or D damage or effect or react slowly with marble statues or ora (1)</p> <p><b>allow</b> C and / or D cause rusting or ora (1)  <b>allow</b> C and / or D damage or effect or react slowly with steel or ora (1)</p> <p><b>Examiner's Comments</b></p> <p>This question assessed Assessment Objective 3 (analyse and evaluate evidence, make reasoned judgements and draw conclusions based on evidence). About two thirds of candidates scored marks on this question. It differentiated well. Most candidates initially discussed the action of the solutions of the gases on marble and/or steel. Less common was a discussion of the pH values of the different solutions.</p>
		<b>Total</b>	<b>3</b>	



### Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
10		<p>sulfur dioxide (causes acid rain) (1)</p> <p><b>but</b></p> <p>(idea of) more sulfur dioxide near volcano / ora (2)</p>		<p><b>not</b> if more than one gas named from the table e.g. sulfur dioxide and hydrogen sulfide (0)</p> <p><b>for second marking point there needs to be a clear comparison e.g.</b> near a volcano it is 1500 and in city it is only 200 (1)</p> <p><b>Examiner's Comments</b></p> <p>Most candidates were able to identify sulfur dioxide. A few candidates did not gain the second mark because they just quoted the figures from the table and did not write a comparative statement about the relative concentration in the air near a volcano compared to that in a city centre. A few candidates also gave the answer of hydrogen sulfide as a cause of acid rain.</p>
		<b>Total</b>	<b>2</b>	
11		<p>(Phil is correct)</p> <p><b>any one from:</b></p> <p>idea that data does not include children / old men / women (1)</p> <p>idea that data does not consider lifestyle (1)</p> <p>idea that data does not include people who live in the country / only includes those living in city (1)</p> <p>idea there may be another reason for asthma / sulfur dioxide may cause asthma (1)</p>	1	<p><b>mark is for explanation</b> <b>if answer Nick then no marks</b> <b>if left blank then mark answer</b></p> <p><b>allow</b> different age groups / genders might be affected differently (1)</p> <p><b>ignore</b> only people living in the city are exposed to nitrogen dioxide</p> <p><b>Examiner's Comments</b></p> <p>The majority of candidates identified the relationship seen in the graph. A few lost the mark for referring to nitrogen rather than nitrogen dioxide or they talked in terms of the numbers of asthma attacks rather than the severity. Most candidates identified the need to collect data from women, other regions or age ranges.</p>
		<b>Total</b>	<b>1</b>	

### Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
12	a	i	470 ± 20 (thousand tonnes) (1)	1	
		ii	<p><b>any two from:</b> less electricity generation (1)</p> <p>idea that more renewable fuels or renewable sources or nuclear fuels used to generate electricity / less fossil fuels burned (1)</p> <p>less energy used for heating / idea of better home insulation (1)</p> <p>reduced manufacturing industry (1)</p> <p>idea of more efficient car engines (1)</p> <p>more electric or hybrid cars (1)</p> <p>better control of emissions (1)</p>	2	<p><b>allow</b> more efficient electricity generation (1) <b>allow</b> people are using less electricity / more energy saving technology (1)</p> <p><b>allow</b> less coal or gas or oil is used (1) <b>allow</b> named renewable used (1) <b>ignore</b> fuel used to make sulfur dioxide could have run out</p> <p><b>allow</b> less factories (1)</p> <p><b>allow</b> removal of sulfur from petrol (1) <b>allow</b> idea of more use of catalytic converters (1)</p> <p><b>ignore</b> fewer cars on the road</p> <p>e.g. (climate change) legislation / filters or scrubbers in factories to reduce sulfur dioxide emissions (1) <b>ignore</b> cleaner car engines <b>ignore</b> people have become more eco-friendly</p>

### Mark Scheme

Question		Answer/Indicative content	Marks	Guidance																	
	b i	<p><b>any three from:</b></p> <p>overall amount of NO<sub>x</sub> decreasing (1)</p> <p>main contributor to NO<sub>x</sub> is road transport (1)</p> <p>less made by road transport (between 1990 and 2010) (1)</p> <p>manufacturing industry stays broadly the same (1)</p> <p>household heating is broadly the same (1)</p> <p>household heating is the least (between 1990 and 2010) (1)</p> <p>idea that electricity generation shows no pattern (1)</p>	3	<p><b>use ticks on this question</b></p> <p><b>allow</b> difference between 1990 and 2010 is 600 (thousand tonnes) (1)</p> <p><b>allow</b> manufacturing industry falls by a small amount or by 10 (thousand tonnes) (1)</p> <p><b>allow</b> idea that electricity generation fluctuates or a description of how it fluctuates (1)</p>																	
	ii	<p>manufacturing industry = 21.8% ± 0.2% (1)</p> <p>generating electricity = 10.9% ± 0.2% (1)</p>	2																		
	c	<p><b>any two from:</b></p> <p>lower (percentage of) NO<sub>x</sub> made by generating electricity in France / greater (percentage of) NO<sub>x</sub> made by generating electricity in the UK (1)</p> <p>greater (percentage of) NO<sub>x</sub> made by household heating in UK / lower (percentage of) NO<sub>x</sub> made by household heating in France (1)</p> <p>lower (percentage of) NO<sub>x</sub> made by road transport in the UK / greater (percentage of) NO<sub>x</sub> made by road transport in France (1)</p> <p>road transport accounts for most oxides of nitrogen pollution in both countries (1)</p> <p>similar percentages made by manufacturing industry (1)</p> <p>household heating creates least NO<sub>x</sub> in both countries (1)</p>	2	<p><b>allow</b> ecf from incorrect percentages calculated in part (b)(ii)</p> <p><b>allow</b> correct percentages quoted even if rounded to the nearest whole number</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2"></th> <th colspan="2">% oxides of nitrogen produced</th> </tr> <tr> <th>UK</th> <th>France</th> </tr> </thead> <tbody> <tr> <td>Road transport</td> <td style="text-align: center;">40</td> <td style="text-align: center;">58.2</td> </tr> <tr> <td>Generating electricity</td> <td style="text-align: center;">20</td> <td style="text-align: center;">10.9</td> </tr> <tr> <td>Manufacturing</td> <td style="text-align: center;">22</td> <td style="text-align: center;">21.8</td> </tr> <tr> <td>Household heat</td> <td style="text-align: center;">16</td> <td style="text-align: center;">9.1</td> </tr> </tbody> </table>		% oxides of nitrogen produced		UK	France	Road transport	40	58.2	Generating electricity	20	10.9	Manufacturing	22	21.8	Household heat	16	9.1
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		<b>Total</b>	<b>10</b>																		

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Question			Answer/Indicative content	Marks	Guidance
13			D ✓	1 (AO 1.1)	<p><b><u>Examiner's Comments</u></b></p> <p>Candidates found this difficult. All responses were seen with A and C being the most common incorrect responses. Only about a quarter of candidates chose the correct response.</p>
			<b>Total</b>	<b>1</b>	
14			C ✓	1 (AO 2.1)	<p><b><u>Examiner's Comments</u></b></p> <p>A was the most popular incorrect response. This question was well answered with about two thirds of candidates choosing the correct response.</p>
			<b>Total</b>	<b>1</b>	
15			A ✓	1 (AO 2.1)	<p><b><u>Examiner's Comments</u></b></p> <p>B and D were popular incorrect choices. This question was well answered with about two thirds of candidates choosing the correct response.</p>
			<b>Total</b>	<b>1</b>	


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Question		Answer/Indicative content	Marks	Guidance
16	a	175 (ppm) ✓	1 (AO 2.1)	<p>ALLOW 165 - 185 inclusive</p> <p><b>Examiner's Comments</b></p> <p>Candidates found the scales difficult to read. 200, 205, 225, 270 and 290 were all seen frequently.</p>
	b	<p><b>Evidence to support increased temperature of the Earth</b> As carbon dioxide levels have increased so has the temperature of the Earth ✓</p> <p><b>Evidence for a natural cycle</b> idea that Earth's temperature goes up and down / fluctuates/erratic (over the years 1880 to 1920) and carbon dioxide levels are (slowly) rising ✓</p>	2 (AO 2 × 2.1)	<p>ALLOW (the lines on) both graphs increase / go up</p> <p><b>Examiner's Comments</b></p> <p>Higher ability candidates linked the rise in temperature and rise in carbon dioxide in the first part of the questions. Many candidates only discussed the change in temperature. Some only mentioned the levels in one particular year. Whilst higher ability candidates appreciated the up and down nature of the temperature, few of them also linked this to the rise in carbon dioxide. Most candidates discussed cycles or seasons on Earth being natural or discussed other features of the Earth and the solar system. Deforestation and burning fuels were both seen quite often.</p>
		<b>Total</b>	<b>3</b>	
17		D ✓	1 (AO 1.1)	<p><b>Examiner's Comments</b></p> <p>This question was answered well. Again it requires candidates to read all the information carefully.</p>
		<b>Total</b>	<b>1</b>	

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18	<p><b>Maximum three marks from:</b>            idea that energy / heat/light or radiation from the Sun reaches the (surface of the) Earth ✓</p> <p>idea that energy / heat/light or radiation is absorbed by the (surface of the) Earth or warms up the (surface of the) Earth ✓</p> <p><b>BUT</b>            energy / heat/light or radiation from the Sun is absorbed by the (surface of the) Earth or warms up the (surface of the) Earth ✓✓</p> <p>idea that energy / heat or infrared (radiation) emitted by the (surface of the) Earth ✓</p> <p>idea that some energy / heat or infrared (radiation) go back into space ✓</p> <p><b>AND at least one mark from:</b>            idea that some energy / heat or infrared (radiation) is absorbed / trapped by greenhouse gas (molecules) in the (Earth's) atmosphere ✓</p> <p>idea that energy / heat or infrared (radiation) from greenhouse gas (molecules) returns to Earth warming the (surface of the) Earth ✓</p>	4 (AO 4×1.1)	<p>IGNORE rays throughout</p> <p>IGNORE            bounce back / reflected/refracted / deflect throughout</p> <p>ALLOW named greenhouse gases</p> <p>ALLOW named greenhouse gases</p> <p>DO NOT ALLOW absorbed or emitted by ozone</p> <p><b><u>Examiner's Comments</u></b>            Candidates had to explain the greenhouse effect. This meant that they needed to mention greenhouse gases at least once in order to be credited full 4 marks. Most candidates lost marks because they did not use the correct terminology or showed a lack of understanding of what was happening to the radiation. Many used the term 'rays' which was ignored. Many also described radiation as 'bouncing' or being 'reflected' off the Earth. This was also ignored. It is important that candidates</p>

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			<p>show understanding of scientific processes by using the correct terminology. Radiation absorbed and emitted is not the same as radiation being bounced off.</p> <div style="text-align: center;">  </div> <p><b>Misconceptions</b></p> <ul style="list-style-type: none"> <li>• Radiation (or heat/energy/light) reflects off the Earth's surface should be absorbed and emitted.</li> <li>• Ozone layer is involved in some way (often described as trapping the heat). It is greenhouse gases such as carbon dioxide that cause some heat to be reflected back to the Earth's surface.</li> <li>• The arrows represented movement of the greenhouse gases, bouncing off the Earth's surface and moving in/out of space. Whereas, the arrows actually represent the passage of infrared radiation.</li> </ul> <p><b>Exemplar 1</b></p> <p><i>At 1, the sun generates heat radiation to Earth and at 2, Earth absorbs the heat and infrared. The radiation radiates off of Earth but at 3, some escapes out to space through the ozone layer. Some of the heat and infrared radiation reflects back down from the ozone to 4, Earth.</i></p> <p>This candidate was able to gain 3 marks. They used the correct terminology; 'radiation', 'absorbs' and 'radiates'. Although they correctly stated that the radiation 'escapes out to space' they did not gain this mark. They had already been credited with 3 marks. The mark scheme states that there must be at least one mark about the role of greenhouse gases in order to fully answer the question. This candidate does not mention greenhouse gases. They incorrectly state radiation 'reflects back down from the ozone'. The</p>

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					candidate has shown they do not know the difference between the ozone and greenhouse gases. This is a common misconception and cannot be credited marks.
			<b>Total</b>	<b>4</b>	