2 These boxes show information about some gases that can pollute the atmosphere.

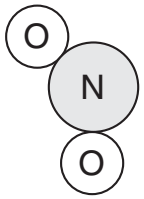
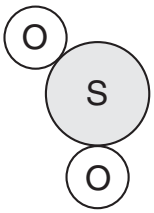
The left hand boxes show the structure of the molecules of the gases.

The centre boxes show the names of the gases.

The right hand boxes give information about where they come from and some of their polluting effects.

Draw lines to join each **molecule** to the **name of the gas** and its **polluting effect**.

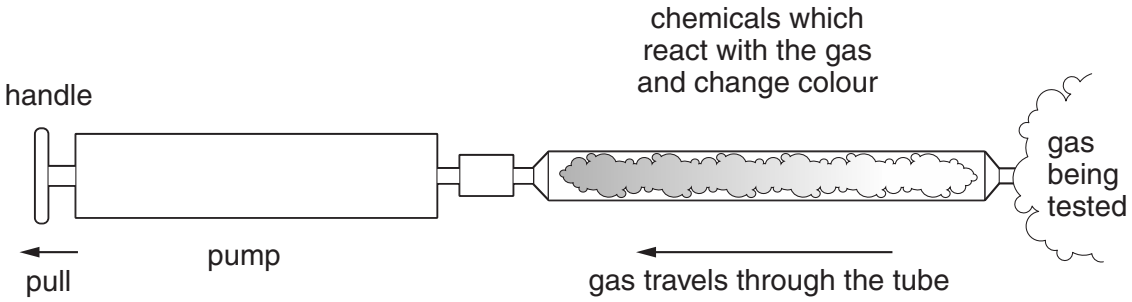
One has been done for you.

structure of molecule	name of the gas	polluting effect
	nitrogen dioxide	Formed at high temperatures in car engines. Makes asthma symptoms worse.
	carbon dioxide	Formed when fuels do not burn completely. Reacts with blood and can be fatal.
	carbon monoxide	Formed when coal or oil containing sulfur burns. Causes acid rain.
	sulfur dioxide	Formed by the complete burning of hydrocarbon fuels. Causes global warming.

[4]

[Total: 4]

4 York High School has a special syringe to measure the concentration of nitrogen oxides (NO_x) in car exhausts.



The students test the head teacher's car.

The car engine was well warmed up and running steadily at a constant speed.

These are the results.

test number	**NO_x concentration** (in parts per billion (ppb))
1	119
2	126
3	113
4	122

(a) Suggest **two** reasons why the students took several readings.

.....

.....

..... [2]

(b) Use the results to calculate the best estimate of the concentration of nitrogen oxides.

You **must** show how you work out your answer.

concentration = ... ppb [2]

(c) Calculate the **range** of the measurements.

range = ... ppb [1]

(d) The students now test the exhaust from the chemistry teacher's car.

The average reading is 147 ppb.

Tick the box beside the **best** description of this result.

The chemistry teacher's car definitely produces more NO_x. ☐

The chemistry teacher's car probably produces more NO_x. ☐

Both cars produce the same amount of NO_x. ☐

The chemistry teacher's car definitely produces less NO_x. ☐ [1]

(e) Explain why it is important to keep the amount of NO_x in the air as low as possible.

.....

.....

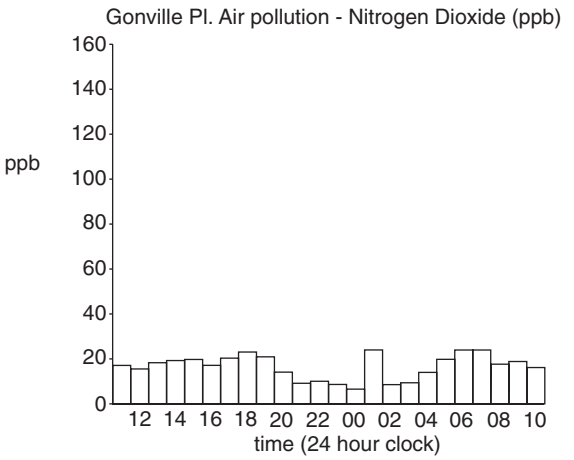
..... [2]

[Total: 8]

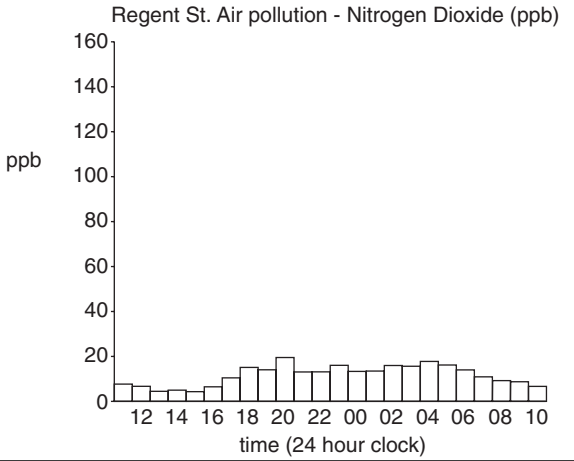
3 Councils measure local air pollution. The information helps them to decide what action they should take to improve air quality. The table shows information about three streets in Cambridge. The sites are normally very busy with traffic.

The graphs show the level of nitrogen dioxide in parts per billion (ppb) in each street on the same day in August 2003.

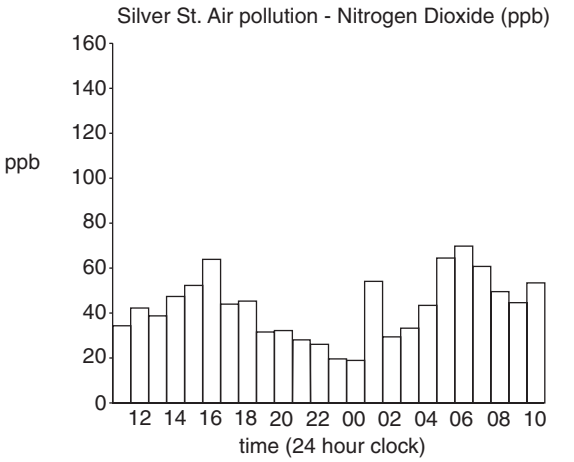
Gonville Place



Regent Street



Silver Street



(a) A local paper made four claims about the pollution levels shown in these graphs.

Tick the boxes to show which **two** statements are true:

The worst nitrogen dioxide pollution was in Silver Street. ☐

The highest level of pollution in Regent Street was at 12 hours. ☐

Pollution levels varied throughout the day. ☐

The highest level of pollution shown is 100 parts per billion (ppb). ☐ [2]

(b) In all three streets, the nitrogen dioxide level is low at midnight (00 hours).

Suggest and explain why.

One mark will be for writing in sentences using correct spelling, punctuation and grammar.

.....

.....

.....

.....[2+1]

(c) Look at the pictures of the three streets. All three normally have heavy traffic.

(i) What correlation can you see between the buildings in these streets and the level of pollution?

.....

.....[2]

(ii) Suggest a reason for this correlation.

.....

.....

.....[1]

(d) Silver Street has now been closed to traffic.

Suggest **two** reasons why local people might object to this.

.....

.....

.....[2]

[Total: 10]

[Turn over

7 These power stations use different fuels in the production of electricity.

A

B

(a) Power station **A** burns natural gas.

Natural gas contains methane.

Methane contains **only** carbon atoms and hydrogen atoms.

(i) What is the name given to chemicals that contain only carbon atoms and hydrogen atoms?

..... [1]

(ii) When natural gas is burned, two main products are given off.

Write down these **two** products.

1 .....

2 ..... [2]

(b) Power station **B** burns coal.
Coal contains mostly carbon. It burns in plenty of air to form carbon dioxide, which enters the atmosphere.

(i) The diagram shows the reaction between carbon and oxygen.

Finish this diagram to show what is produced.

carbon atom + oxygen molecule → carbon dioxide molecule

[1]

(ii) Some carbon dioxide is removed from the atmosphere.

State **two** ways that carbon dioxide is removed from the atmosphere.

1 .....

.....

2 .....

.....[2]

(c) Burning coal or natural gas can also produce sulfur dioxide as a pollutant.

Scientists in both of the power stations shown have taken steps to reduce this sulfur dioxide pollution.

(i) State **one** way to reduce sulfur dioxide pollution caused by a coal burning power station.

.....[1]

(ii) State a **different** way to reduce sulfur dioxide pollution caused by a natural gas burning power station.

.....[1]

(iii) The government has agreed to reduce all air pollution from power stations.

Suggest **one** way this can be done.

.....[1]

[Total: 9]

4 Some cars now have two fuel tanks. They are called 'dual fuel' cars and can either burn liquefied petroleum gas (LPG) or normal petrol. The extra cost compared to a normal petrol car is £1800.

LPG is a 'cleaner' fuel than petrol. Unlike petrol, it contains no sulfur. When it burns, it makes less carbon monoxide, much less nitrogen oxides and fewer solid particles of soot. It also costs about half as much as petrol.

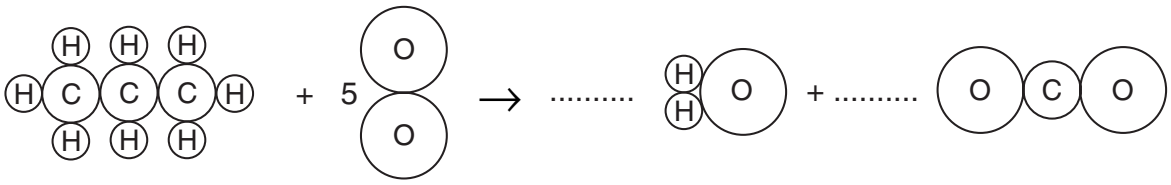
Not all garages sell LPG, so these cars have two fuel tanks, one for each fuel. This makes little difference to the performance of the car, but it takes up extra space, so usually the boot will be smaller.

Drivers usually use LPG, and the car will automatically switch to petrol when the gas tank is empty.

(a) LPG is mainly propane, C_3H_8. Propane burns in air to produce water and carbon dioxide.

propane + oxygen $\longrightarrow$ water + carbon dioxide

Complete the diagram below to show how many water molecules and carbon dioxide molecules are produced when propane burns.



[2]

(b) An average family car covers 12 000 miles each year.

If it ran on petrol for all of the year, it would give out 3 tonnes of carbon dioxide.

If the car ran on LPG for the same distance, it would use 0.6 tonnes of LPG.

Each tonne of LPG which is burned gives out 3 tonnes of carbon dioxide.

(i) Calculate the mass of carbon dioxide given out by burning 0.6 tonnes of LPG.

mass = ... tonne [1]

(ii) Calculate how much **less** carbon dioxide is released into the atmosphere as a result of burning LPG instead of petrol.

mass = ... tonne [1]

(c) When running on LPG, the car does 6 miles to the litre. A litre of LPG costs 36 p.

Calculate the fuel cost per mile when using LPG.

fuel cost = ... pence per mile [1]

[Turn over

(d) Using LPG saves 3 p per mile compared with using petrol.

(i) Calculate the money saved in fuel costs if all 12 000 miles each year were fuelled by LPG, rather than petrol.

savings = ... [1]

(ii) Calculate the number of years it would take to recover the £1800 cost of installing a dual fuel system if all 12 000 miles each year were fuelled by LPG, rather than petrol.

time = ... years [1]

(e) Describe the advantages **and** disadvantages of running a dual fuel car.

advantages .....

.....

.....

disadvantages .....

.....

..... [4]

[Total: 11]