Exercise walk-through

9.3
Atmospheric pollutants and their sources (4.9.3.1–4.9.3.2)

AQA · GCSE · Chemistry

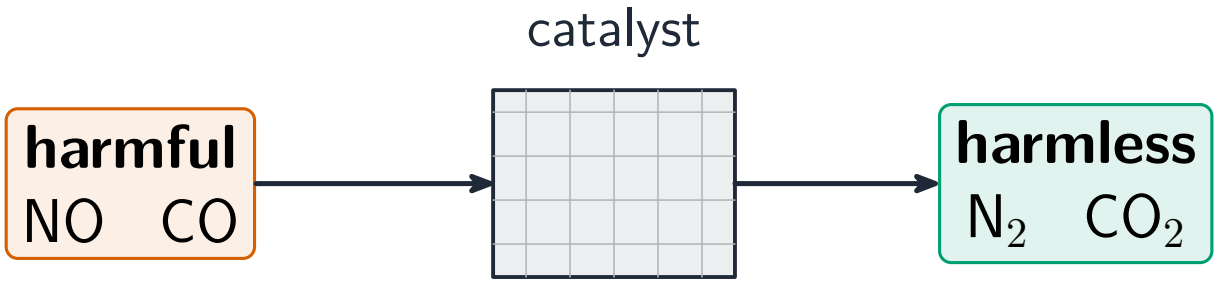
Pollutants from burning fuels

- Complete combustion of a **pure hydrocarbon** in plenty of oxygen gives carbon dioxide and water: $\mathrm{CH_4} + 2\mathrm{O_2} \rightarrow \mathrm{CO_2} + 2\mathrm{H_2O}$.
- **Incomplete combustion** , in too little oxygen, also gives **carbon monoxide** and **soot** , solid carbon particles. **Particulates** are small solid particles and unburnt hydrocarbons released into the air.

Pollutants from burning fuels (2)

- Sulfur in the fuel burns to form sulfur dioxide: $\mathrm{S} + \mathrm{O}_2 \rightarrow \mathrm{SO}_2$.
- In the high temperature of an engine, nitrogen and oxygen from the air react to form **nitrogen oxides** (NO_x). The nitrogen comes from the air, not the fuel.

Figure: Pollutants from burning fuels

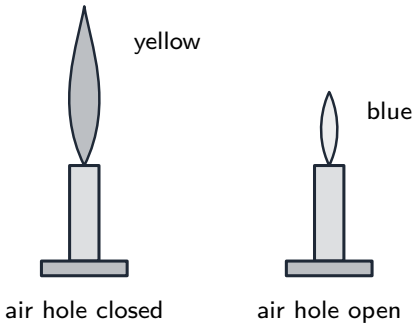


$$2NO + 2CO \rightarrow N_2 + 2CO_2$$

- A **catalytic converter** uses **carbon monoxide** to reduce nitrogen monoxide to nitrogen, forming carbon dioxide
- Match each part of the diagram to the text.

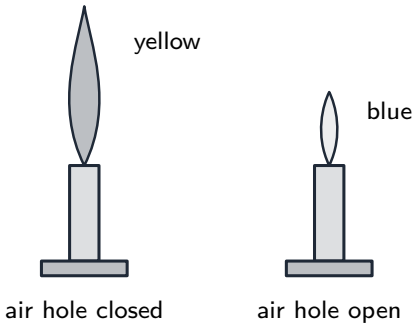
Exercise 2.1

2.1 A Bunsen burner with its air hole closed gives a yellow flame. Explain why this flame makes soot. [2]



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2.1

- there is not enough oxygen, so combustion is incomplete; some carbon in the fuel is left as soot

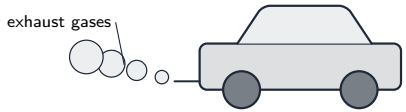
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Exercises 2.2·3.1

2.2 Homes with gas boilers often have a carbon monoxide alarm. Explain why carbon monoxide is dangerous. [2]



3.1 Car exhaust gases contain oxides of nitrogen. Explain how they form. [3]



Exercises 2.2·3.1

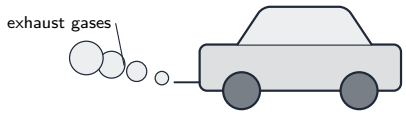
2.2 Homes with gas boilers often have a carbon monoxide alarm. Explain why carbon monoxide is dangerous. [2]



2.2

- it is toxic: it stops the blood carrying oxygen; it has no colour or smell, so people cannot tell it is there

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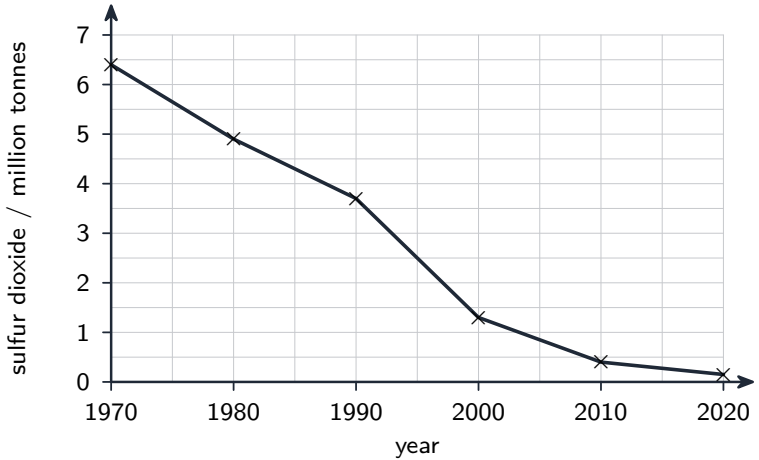
3.1

- nitrogen and oxygen from the air
- react together
- at the high temperature inside the engine

Exercise 3.2 (a)

3.2 The graph shows the mass of sulfur dioxide given out each year in the UK.

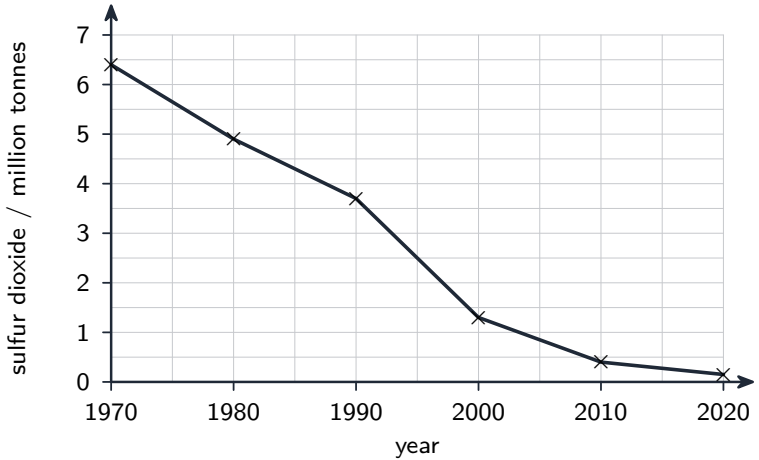
(a) Describe the trend, and find the fall from 1970 to 2000. [2]



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(a) emissions fall every decade; $6.4 - 1.3 =$ about **5.1** million tonnes

Exercise 3.2 (b)

3.2 The graph shows the mass of sulfur dioxide given out each year in the UK.

(b) Explain how sulfur dioxide forms when fuels burn, and give **two** harmful effects. [3]

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(b) Explain how sulfur dioxide forms when fuels burn, and give **two** harmful effects. [3]

(b) sulfur in the fuel reacts with oxygen when the fuel burns; acid rain; breathing problems

Exercise 3.2 (c)

3.2 The graph shows the mass of sulfur dioxide given out each year in the UK.

(c) Suggest **two** reasons for the fall in sulfur dioxide emissions. [2]

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(c) less coal burned in power stations, with more gas and renewables; sulfur removed from fuels or from waste gases

Exercise 3.2 (d)

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(d) Compare the pollutants carbon monoxide, soot, sulfur dioxide and oxides of nitrogen. Describe how each forms and its effects. [6]

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(d) points to include:

- carbon monoxide and soot come from incomplete combustion, when there is not enough oxygen
- carbon monoxide is toxic: it stops the blood carrying oxygen
- soot damages lungs and causes global dimming
- sulfur dioxide comes from sulfur in the fuel
- oxides of nitrogen come from nitrogen and oxygen in the air reacting in hot engines
- both sulfur dioxide and oxides of nitrogen cause acid rain and breathing problems

Levels: **5–6** a full, logical answer with correct chemistry and correct terms; **3–4** several correct points, partly linked; **1–2** one or two relevant points.