

1 The following substances can be formed when petrol is burnt in a car engine.

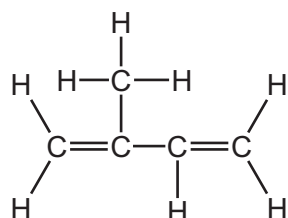
Which substance is the main cause of acid rain?

- A carbon
- B carbon monoxide
- C nitrogen dioxide
- D water

[1]

[Total: 1]

2 When rubber is distilled, a chemical called isoprene is formed.
The structure of isoprene is shown below.



State the names of **two** substances formed when isoprene undergoes incomplete combustion.

..... and

[2]

[Total: 2]

3 Some plastics contain sulfur.

Explain why plastics containing sulfur are harmful to the environment when burned.

.....

.....

[2]

[Total: 2]

- 4 Sulfur dioxide is an atmospheric pollutant.

Describe how sulfur dioxide is formed and how it gets into the atmosphere.

.....

.....

..... [2]

[Total: 2]

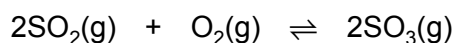
- 5 What is the percentage by volume of oxygen in the air?

..... [1]

[Total: 1]

- 6 Sulfuric acid is made by the Contact process.

(a) The following equation represents the equilibrium in the Contact process.



Oxygen is supplied from the air.

The composition of the reaction mixture is 1 volume of sulfur dioxide to 1 volume of oxygen.

What volume of air contains 1 dm³ of oxygen?

..... [1]

(b) Sulfur dioxide is more expensive than air.

What is the advantage of using an excess of air?

.....

..... [2]

(c) The forward reaction is exothermic. The reaction is usually carried out at a temperature between 400 and 450 °C.

(i) What is the effect on the position of equilibrium of using a temperature above 450 °C? Explain your answer.

.....

.....

..... [2]

- (ii) What is the effect on the rate of using a temperature below 400 °C?
Explain your answer.

.....

 [3]

- (d) A low pressure, 2 atmospheres, is used. At equilibrium, about 98% SO₃ is present.

- (i) What is the effect on the position of equilibrium of using a higher pressure?

..... [1]

- (ii) Explain why a higher pressure is **not** used.

..... [1]

[Total: 10]

- 7 Glycolic acid is prepared by heating a mixture of methanal, carbon monoxide and water with a sulfuric acid catalyst.

State **one** adverse effect of carbon monoxide on humans.

..... [1]

[Total: 1]

- 8 Sulfur, present in coal, is one major cause of acid rain. Sulfur burns to form sulfur dioxide which reacts with rain water to form sulfuric acid.

Give **two** harmful effects of acid rain.

.....
 [2]

[Total: 2]

- 9** Sulfur, present in coal, is one major cause of acid rain. Sulfur burns to form sulfur dioxide which reacts with rain water to form sulfuric acid.

Describe how the high temperatures in vehicle engines are another cause of acid rain.

.....

 [3]

[Total: 3]

- 10** Oxides of nitrogen are atmospheric pollutants.

State **one** adverse effect of oxides of nitrogen on health.

..... [1]

[Total: 1]

- 11** Oxides of nitrogen are formed when ammonia is heated with oxygen in the presence of a catalyst.

(a) Suggest why a catalyst is used.

..... [1]

(b) State **one** other process which puts oxides of nitrogen into the atmosphere.

..... [1]

(c) State **one** adverse effect of oxides of nitrogen on health.

..... [1]

[Total: 3]

- 12** When carbon burns in a limited supply of air, a poisonous gas is formed.

Name this gas.

..... [1]

[Total: 1]

- 13** This question is about Group IV elements and their compounds.

Lead compounds are pollutants in the air.

(a) State **one** source of lead compounds in the air.

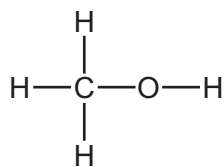
..... [1]

(b) State **one** adverse effect of lead compounds on health.

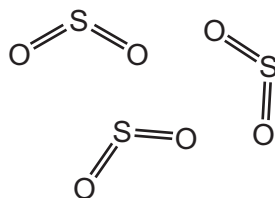
..... [1]

[Total: 2]

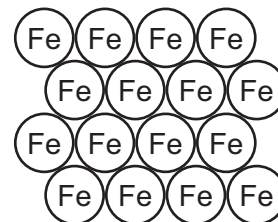
14 The diagrams show part of the structures of five substances, **A**, **B**, **C**, **D** and **E**.



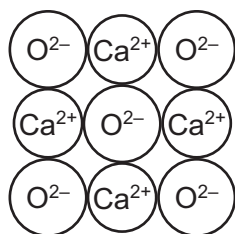
A



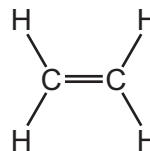
B



C



D



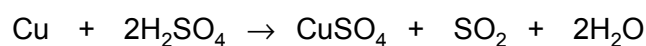
E

State which **one** of these structures, **A**, **B**, **C**, **D** or **E** contributes to acid rain.

..... [1]

[Total: 1]

15 The chemical equation for the reaction of copper with hot concentrated sulfuric acid is shown.



One of the compounds in this equation is a pollutant gas which contributes to acid rain.

Identify the pollutant gas and state a common source of it.

pollutant gas

source [2]

[Total: 2]

16 What percentage of clean, dry air is oxygen?

..... [1]

[Total: 1]

17 Answer the following question using only the substances in the list.

ammonia bauxite carbon dioxide carbon monoxide
hematite oxygen sodium chloride sulfur dioxide

State which substance is a toxic gas produced during the incomplete combustion of hydrocarbons.

..... [1]

[Total: 1]

18 The following formulae represent different substances.

Al Ag CaCO₃ CH₄ Cl₂ Cu SO₂

State which of these substances is a cause of acid rain.

..... [1]

[Total: 1]

19 The carbon monoxide in the exhaust gases from petrol engines comes from the incomplete combustion of hydrocarbons.

Give **one** adverse effect of carbon monoxide on health.

..... [1]

[Total: 1]

- 20 The table shows the percentage by volume of each of the gases present in the exhaust gases from a petrol engine and a diesel engine.

| name | percentage by volume from a petrol engine | percentage by volume from a diesel engine |
|--------------------|---|---|
| nitrogen | 72.00 | 67.00 |
| carbon dioxide | 14.00 | |
| water vapour | 12.00 | 11.00 |
| carbon monoxide | 1.50 | 0.05 |
| oxides of nitrogen | 0.25 | 0.70 |
| hydrocarbons | 0.24 | 0.22 |
| sulfur dioxide | 0.01 | 0.03 |
| oxygen | 0.00 | 9.00 |
| | total 100.00 | total 100.00 |

Describe **three** ways in which the composition of the exhaust gases from the petrol engine differ from the composition of the exhaust gases from the diesel engine.

1

2

3 [3]

[Total: 3]

- 21 The table shows the percentage by volume of each of the gases present in the exhaust gases from a petrol engine.

| name | percentage by volume |
|------------------|----------------------|
| carbon monoxide | 1.0 |
| carbon dioxide | |
| hydrogen | 0.2 |
| nitrogen | 77.0 |
| nitrogen dioxide | 0.3 |
| oxygen | 0.7 |
| hydrocarbons | 0.3 |
| water vapour | 5.0 |
| | total 100.0 |

(a) Calculate the percentage by volume of carbon dioxide in the exhaust gases.

..... % [1]

(b) Which gas shown in the table is present in the lowest percentage by volume?

..... [1]

[Total: 2]

22 The table shows the percentage by volume of each of the gases present in the exhaust gases from a petrol engine with a catalytic converter.

| name | percentage by volume |
|--------------------|----------------------|
| carbon monoxide | 0.20 |
| carbon dioxide | 15.00 |
| hydrocarbons | 0.02 |
| hydrogen | 0.01 |
| nitrogen | |
| oxides of nitrogen | 0.02 |
| water vapour | 2.75 |
| total | 100.00 |

(a) Calculate the percentage by volume of nitrogen in the exhaust gases.

..... % [1]

(b) Which gas shown in the table is present in the lowest percentage by volume?

..... [1]

[Total: 2]

23 The names of seven gases are given.

ammonia
ethene
helium
hydrogen
hydrogen chloride
methane
nitrogen

State which gas forms 78% of clean, dry air.

..... [1]

[Total: 1]

24 The table shows the percentage by volume of each of the gases present in the exhaust gases from a petrol engine and a diesel engine.

| name | percentage by volume from a petrol engine | percentage by volume from a diesel engine |
|--------------------|--|--|
| nitrogen | 72.00 | 67.00 |
| carbon dioxide | 14.00 | |
| water vapour | 12.00 | 11.00 |
| carbon monoxide | 1.50 | 0.05 |
| oxides of nitrogen | 0.25 | 0.70 |
| hydrocarbons | 0.24 | 0.22 |
| sulfur dioxide | 0.01 | 0.03 |
| oxygen | 0.00 | 9.00 |
| | total 100.00 | total 100.00 |

In the diesel engine, nitrogen, carbon dioxide and water vapour account for 90.00% of the exhaust gases by volume.

Calculate the percentage by volume of carbon dioxide in the exhaust gases from the diesel engine.

..... % [1]

[Total: 1]

25 Give **one** adverse effect of sulfur dioxide on health.

..... [1]

[Total: 1]

26 The following substances are gases at room temperature.

| letter | A | B | C | D | E | F | G | H |
|-----------|-----------------|----|----|-----------------|-----------------|-----------------|-----------------|-------------------------------|
| substance | SO ₂ | Ar | CO | Cl ₂ | NH ₃ | CO ₂ | CH ₄ | C ₃ H ₈ |

Identify, by letter:

a gas which combines with water to form acid rain..... [1]

[Total: 1]

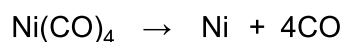
27 Sulfur dioxide is an atmospheric pollutant.

Give **one** adverse effect of sulfur dioxide on health.

..... [1]

[Total: 1]

28 The tetracarbonylnickel is heated to obtain pure nickel.



State **one** adverse effect of carbon monoxide on health.

..... [1]

[Total: 1]

29 Sulfur dioxide is an atmospheric pollutant.

State **one** source of sulfur dioxide.

..... [1]

[Total: 1]

30 State the conditions needed for iron to rust.

..... [2]

[Total: 2]

- 31 Sulfur dioxide, carbon monoxide and oxides of nitrogen are common gaseous pollutants found in the air.

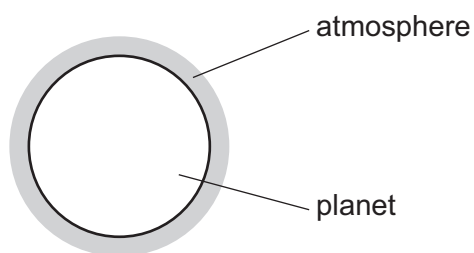
Which pollutants contribute to acid rain?

- A carbon monoxide and sulfur dioxide
- B oxides of nitrogen and sulfur dioxide
- C oxides of nitrogen only
- D sulfur dioxide only

[1]

[Total: 1]

- 32 A new planet has been discovered and its atmosphere has been analysed.



The table shows the composition of its atmosphere.

| gas | percentage by volume |
|----------------|----------------------|
| carbon dioxide | 4 |
| nitrogen | 72 |
| oxygen | 24 |

Which gases are present in the atmosphere of the planet in a higher percentage than they are in the Earth's atmosphere?

- A carbon dioxide and oxygen
- B carbon dioxide only
- C nitrogen and oxygen
- D nitrogen only

[1]

[Total: 1]

33 Lead compounds are atmospheric pollutants.

State **one** adverse effect of lead compounds on health.

..... [1]

[Total: 1]

34 State **one** adverse effect of carbon monoxide on health.

..... [1]

[Total: 1]

35 Sulfur dioxide, SO₂, is harmful to the environment.

Explain why it is harmful to the environment and state **one** effect it has on buildings.

.....
..... [2]

[Total: 2]

36 This question is about solids and gases.

(a) The list gives the names of eight substances which are gases at room temperature.

ammonia

butane

carbon dioxide

carbon monoxide

chlorine

methane

propene

sulfur dioxide

Answer the following questions about these gases.

Each gas may be used once, more than once or not at all.

State which gas:

- (a) is a poisonous product formed by the incomplete combustion of carbon
 [1]
- (b) is an alkene
 [1]
- (c) is formed when limestone is thermally decomposed
 [1]
- (d) is an element
 [1]
- (e) causes acid rain.
 [1]
- [Total: 5]

37 Iron often rusts.

Name the **two** substances, other than iron, that must be present for iron to rust.

- 1 [1]
- 2 [1]
- [Total: 1]

38 Sulfur dioxide is a toxic gas.

- (a) State one **environmental** reason why sulfur dioxide should not be released into the atmosphere.
 [1]
- (b) Describe the test for sulfur dioxide.
- test

- observations
 [2]
- [Total: 3]

39 Iron can be converted into steel in a basic oxygen converter.

Oxygen is blown into the impure molten iron to remove some of the impurities.

- (a) Oxygen reacts with the carbon in the impure iron to form carbon dioxide.

Write a chemical equation for this reaction.

..... [2]

- (b) Basic oxides in the lining of the converter react with impurities such as sulfur dioxide to form slag.

What type of oxide is sulfur dioxide?

Give a reason for your answer.

.....

..... [2]

[Total: 4]

- 40 Sulfur dioxide is a pollutant in the air.

- (a) State **one** source of sulfur dioxide in the air.

..... [1]

- (b) Sulfur dioxide is oxidised to sulfur trioxide in the air.
Oxides of nitrogen act as catalysts for this reaction.

What is meant by the term *catalyst*?

.....

..... [1]

- (c) Sulfur trioxide dissolves in rainwater to form acid rain.

Which **one** of the following pH values could be the pH of acid rain?

Draw a circle around the correct answer.

pH 4 pH 7 pH 9 pH 13 [1]

- (d) State **one** adverse effect of acid rain on buildings.

..... [1]

[Total: 4]