C9
CHEMISTRY OF THE ATMOSPHERE
TEST 2

GCSE
CHEMISTRY
AQA - COMBINED SCIENCE

Materials
For this paper you must have:
- Ruler
- Pencil, Rubber, Protractor and Compass
- Scientific calculator, which you are expected to use when appropriate

Instructions
- Answer all questions
- Answer questions in the space provided
- All working must be shown
- Do all rough work in this book. Cross out any rough work you don't want to be marked

Information
- The marks for the questions are shown in brackets
This question is about gases in the air.

The diagram below represents a molecule found in air.

\[ \text{O} = \text{C} = \text{O} \]

(a) What is the formula of the molecule shown in the diagram above?

Tick one box.

- Co2
- 2CO
- CO₂
- CO²

(b) What is the name of the molecule shown in the diagram above?

You may use the periodic table to help you.

___________________________________________________________________

(1)

(c) The percentage of oxygen in air is 21%.

The mass of air in a classroom was 220 kg

Calculate the mass of oxygen in the classroom.

___________________________________________________________________

___________________________________________________________________

Mass of oxygen = ________________ kg

(1)
Carbon monoxide is an air pollutant.

(d) Describe how carbon monoxide is produced from fuels.

(2)

(e) Carbon monoxide can decrease the concentration of oxygen in the blood.

Which part of the blood would be most affected by carbon monoxide?

Tick one box.

Red blood cells

Plasma

Platelets

White blood cells

(1)
(f) What two effects could a decreased concentration of oxygen in the blood have on body cells?

Tick two boxes.

- Cell death
- Decreased respiration rate
- Faster cell division
- Faster cell growth
- More energy released

(g) Some air pollutants cause acid rain.

Give one problem caused by acid rain.

___________________________________________________________________
___________________________________________________________________

(Total 9 marks)

The table shows the percentage of some gases in the atmosphere on Earth and on Venus.

<table>
<thead>
<tr>
<th>Gas</th>
<th>Percentage of gas in atmosphere</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Earth</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>78.08</td>
</tr>
<tr>
<td>Oxygen</td>
<td>20.95</td>
</tr>
<tr>
<td>Carbon dioxide</td>
<td>0.04</td>
</tr>
</tbody>
</table>
(a) Give two differences in the atmosphere on Earth compared with the atmosphere on Venus.

1. _________________________________________________________________
   ___________________________________________________________________

2. _________________________________________________________________
   ___________________________________________________________________

(2)

(b) Give a source of each of the gases below that are found in the Earth’s atmosphere.

Carbon dioxide ______________________________________________________
   ___________________________________________________________________

Oxygen ____________________________________________________________
   ___________________________________________________________________

(2)

(c) Water moves between the Earth and its atmosphere.

Describe how water enters and leaves the atmosphere.

How water enters the atmosphere _______________________________________
   ___________________________________________________________________

How water leaves the atmosphere _______________________________________
   ___________________________________________________________________

(2)

(d) The percentage of carbon dioxide in the Earth’s atmosphere is increasing.

What environmental problem is caused by the increased percentage of carbon dioxide in the atmosphere?

Tick one box.

Deforestation

Destruction of peat bogs

Global warming

Pollution of streams

(1)
(e) Suggest **two** negative impacts of climate change.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(Total 9 marks)

The table shows the gases in the Earth’s atmosphere today.

<table>
<thead>
<tr>
<th>Gas</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N₂</td>
<td>78.0</td>
</tr>
<tr>
<td>O₂</td>
<td>21.0</td>
</tr>
<tr>
<td>Ar</td>
<td>0.9</td>
</tr>
<tr>
<td>Other gases</td>
<td>X</td>
</tr>
</tbody>
</table>

(a) What is the percentage of X?
Tick one box.

0.01% [ ] 0.1% [ ] 1% [ ] 10% [ ] (1)
(b) Complete Figure 1.

Plot the data from the table on Figure 1.

Figure 1

(c) What is the name of the gas with symbol Ar?

Tick one box.

Aluminium

Argon

Arsenic

Astatine
Some theories suggest that the Earth’s early atmosphere was the same as the atmosphere of Mars today.

Describe the change in the percentage of oxygen from the Earth’s early atmosphere to the Earth’s atmosphere today.

Use values from the table and **Figure 2**.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(2)
(e) **Figure 3** shows the percentage of greenhouse gases from human activities.

![Figure 3](image)

Compare the contribution of each activity to the total amount of greenhouse gases.

Use data from **Figure 3**.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(f) Suggest **one** way greenhouse gas emissions could be reduced.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(1)
(g) Give one reason why it is difficult for some countries to reduce emissions of greenhouse gases.

___________________________________________________________________
___________________________________________________________________

(Total 11 marks)

Rose black spot is a disease that affects rose plants.
The leaves of infected plants develop black spots, then turn yellow and drop off the plant.

(a) Give the name of the substance in leaves that is broken down when leaves change from green to yellow.

___________________________________________________________________

Total 11 marks

(b) Rose black spot can be transferred between plants in water droplets.

Draw one line from each method of black spot prevention to the explanation of why that method works.

<table>
<thead>
<tr>
<th>Method</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant roses with large gaps between plants</td>
<td>Fungus spores are removed</td>
</tr>
<tr>
<td></td>
<td>Helps leaves dry faster</td>
</tr>
<tr>
<td>Clear dead leaves</td>
<td>Increases infection in warm weather</td>
</tr>
<tr>
<td></td>
<td>Prevents rain falling on the leaves</td>
</tr>
</tbody>
</table>

(2)
(c) Fungicides can be sprayed on rose plants to prevent infection with black spot. Some fungicides appear to be less effective than they were 10 years ago. Suggest why the fungicides are less effective now compared with 10 years ago.

___________________________________________________________________
___________________________________________________________________

(1)

Some gardeners claim that rose black spot has become more of a problem since the Clean Air Act of 1958.

The table shows how the mass of sulfur dioxide (SO2) emissions has changed.

<table>
<thead>
<tr>
<th>Year</th>
<th>SO2 emissions from each source in megagrams</th>
<th>Total SO2 emissions in megagrams</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Power stations</td>
<td>Manufacturing industry</td>
</tr>
<tr>
<td>1970</td>
<td>3300</td>
<td>1750</td>
</tr>
<tr>
<td>1980</td>
<td>3250</td>
<td>900</td>
</tr>
<tr>
<td>1990</td>
<td>2900</td>
<td>450</td>
</tr>
<tr>
<td>2000</td>
<td>900</td>
<td>150</td>
</tr>
<tr>
<td>2010</td>
<td>250</td>
<td>100</td>
</tr>
</tbody>
</table>

(d) The sulfur dioxide emissions in the table are shown in megagrams. Calculate value X in the table.

___________________________________________________________________
___________________________________________________________________

\[ X = \text{__________________________ Mg} \] (1)

(e) Give your answer to part (d) in kilograms. 1 megagram = 1000 kilograms

___________________________________________________________________
___________________________________________________________________

\[ X = \text{__________________________ Kg} \] (1)
(f) How have power stations reduced their sulfur dioxide emissions?

Tick one box.

- Power stations used more at night than during the day
- Power stations generate more electricity
- Power stations use less coal
- Power stations use more oil

(1)

A gardener concluded that the information in the table shows the Clean Air Act of 1958 changed sulfur dioxide emissions.

(g) Give one reason to support the conclusion.

___________________________________________________________________
___________________________________________________________________
(1)

(h) Give one reason why the conclusion may not be valid.

___________________________________________________________________
___________________________________________________________________
(1)

(i) Suggest how changing sulfur dioxide emissions increased the number of cases of rose black spot.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
(2)

(Total 11 marks)
A mixture of petrol and air is burned in a car engine. Petrol is a mixture of alkanes. Air is a mixture of gases.

The tables give information about the composition of petrol and the composition of air.

<table>
<thead>
<tr>
<th>Petrol</th>
<th>Air</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Alkane</strong></td>
<td><strong>Gas</strong></td>
</tr>
<tr>
<td>hexane</td>
<td>nitrogen</td>
</tr>
<tr>
<td>heptane</td>
<td>oxygen</td>
</tr>
<tr>
<td>octane</td>
<td>carbon dioxide</td>
</tr>
<tr>
<td>nonane</td>
<td>Small amounts of other gases and</td>
</tr>
<tr>
<td>decane</td>
<td>water vapour</td>
</tr>
</tbody>
</table>

(a) Use the information above to answer these questions.

(i) Give the formula for heptane

______________________________________________________________

(1)

(ii) Complete the general formula of alkanes.
\[ n = \text{number of carbon atoms} \]

\[ C_n \text{H} \]

(1)

(b) Alkanes in petrol burn in air.

The equations represent two reactions of hexane burning in air.

**Reaction 1** \[ 2C_6H_{14} + 19O_2 \rightarrow 12CO_2 + 14H_2O \]

**Reaction 2** \[ 2C_6H_{14} + 13O_2 \rightarrow 12CO + 14H_2O \]

**Reaction 2** produces a different carbon compound to **Reaction 1**.

(i) Name the carbon compound produced in **Reaction 2**.

______________________________________________________________

(1)

(ii) Give a reason why the carbon compounds produced are different.

______________________________________________________________

______________________________________________________________

(1)
The table shows the percentages of some gases in the exhaust from a petrol engine.

<table>
<thead>
<tr>
<th>Name of gas</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>nitrogen</td>
<td>68</td>
</tr>
<tr>
<td>carbon dioxide</td>
<td>15</td>
</tr>
<tr>
<td>carbon monoxide</td>
<td>1.0</td>
</tr>
<tr>
<td>oxygen</td>
<td>0.75</td>
</tr>
<tr>
<td>nitrogen oxides</td>
<td>0.24</td>
</tr>
<tr>
<td>hydrocarbons</td>
<td>0.005</td>
</tr>
<tr>
<td>sulfur dioxide</td>
<td>0.005</td>
</tr>
<tr>
<td>other gases</td>
<td></td>
</tr>
</tbody>
</table>

(i) What is the percentage of the other gases in the table?

(ii) What is the name of the compound that makes up most of the other gases?

(iii) Give a reason why sulfur dioxide is produced in a petrol engine.

(iv) State how nitrogen oxides are produced in a petrol engine.
(d) Many scientists are concerned about the carbon dioxide released from burning fossil fuels such as petrol.

Explain why.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(2)

(Total 11 marks)

(a) Methane is burned in a plentiful supply of oxygen.

Which is the correct balanced chemical equation?

Tick one box.

\[ \text{CH}_4 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O} \]

\[ \text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O} \]

\[ \text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O} \]

\[ \text{CH}_4 + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 2\text{H}_2\text{O} \]

(1)

(b) Burning fuels causes atmospheric pollution.

Write one effect for each pollutant in Table 1.

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon monoxide</td>
<td></td>
</tr>
<tr>
<td>Sulfur dioxide</td>
<td></td>
</tr>
<tr>
<td>Particulates</td>
<td></td>
</tr>
</tbody>
</table>

(3)
(c) Methane, petrol and coal are fuels.

**Table 2** shows information about these fuels.

<table>
<thead>
<tr>
<th>Fuel</th>
<th>State</th>
<th>Energy content in kJ per g</th>
<th>Mass in mg of CO$_2$ produced for one kJ of energy released</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methane</td>
<td>Gas</td>
<td>52</td>
<td>53</td>
</tr>
<tr>
<td>Petrol</td>
<td>Liquid</td>
<td>43</td>
<td>71</td>
</tr>
<tr>
<td>Coal</td>
<td>Solid</td>
<td>24</td>
<td>93</td>
</tr>
</tbody>
</table>

Evaluate the use of the fuels.

Use in the information in **Table 2** and your knowledge.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(6) 
(Total 10 marks)
There is limited evidence about the Earth’s early atmosphere because of the age of the Earth.

(a) The Earth is 4.6 billion years old.

Which is the correct age of the Earth?

Tick one box.

4.6 × 10³ years

4.6 × 10⁶ years

4.6 × 10⁹ years

4.6 × 10¹² years

(1)

Scientists think that the Earth’s early atmosphere may have been similar to the atmosphere on Mars today.

Look at the table below.

<table>
<thead>
<tr>
<th>Gas</th>
<th>Concentration of gas in the atmosphere today in parts per million</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mars</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>27 000</td>
</tr>
<tr>
<td>Oxygen</td>
<td>1 300</td>
</tr>
<tr>
<td>Argon</td>
<td>16 000</td>
</tr>
<tr>
<td>Carbon dioxide</td>
<td>950 000</td>
</tr>
<tr>
<td>Carbon monoxide</td>
<td>800</td>
</tr>
</tbody>
</table>
(b) Calculate the percentage increase in nitrogen from the Earth’s early atmosphere to the atmosphere today.

Assume the Earth’s early atmosphere was the same as the atmosphere today on Mars.

Give your answer to 2 significant figures.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

Percentage increase in nitrogen = ____________ %

(3)

(c) Which process releases carbon monoxide into the Earth’s atmosphere?

Tick one box.

Aerobic respiration

Bacterial decomposition

Incomplete combustion

Photosynthesis

(1)

(d) Explain how the oceans were formed in the first billion years of the Earth’s existence.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(2)
(e) Describe how the increase in greenhouse gases has increased the mass of liquid water in the oceans.

(1)

(Total 8 marks)