

# Chem!stry

Name: ..... ( )

Class: .....

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## Assignment on Atmosphere and Pollution – Answers

### Question 1.

When fossil fuels are burnt in a motor car, the following gases are emitted from the car's exhaust.

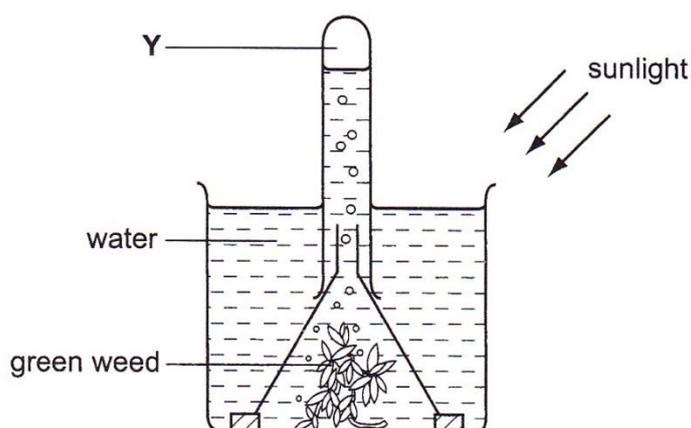
- 1  $C_8H_{18}$
- 2 CO
- 3  $NO_2$
- 4  $SO_2$

Which gases are the result of incomplete combustion?

- |          |          |          |          |
|----------|----------|----------|----------|
| <b>A</b> | 1 and 4. | <b>B</b> | 2 and 3. |
| <b>C</b> | 3 and 4. | <b>D</b> | 1 and 2. |

### Question 2.

The diagram shows a common laboratory experiment.



Which gas is being collected at Y?

- |          |                 |          |           |
|----------|-----------------|----------|-----------|
| <b>A</b> | Carbon dioxide. | <b>B</b> | Hydrogen. |
| <b>C</b> | Nitrogen.       | <b>D</b> | Oxygen.   |



**Question 7.**

Molecules present in car exhaust fumes include carbon dioxide, carbon monoxide, nitrogen, nitrogen dioxide, sulfur dioxide and water. Which of these molecules are also present in unpolluted air?

- A Nitrogen only.
- B Nitrogen and water only.
- C Nitrogen, carbon dioxide and water only.
- D Nitrogen, carbon monoxide, carbon dioxide and water only.

**Question 8.**

In which pair do both pollutants cause damage to buildings?

- A Carbon monoxide and nitrogen monoxide.
- B Carbon monoxide and sulfur dioxide.
- C Nitrogen dioxide and sulfur dioxide.
- D Nitrogen monoxide and carbon dioxide.

**Question 9.**

Air contains 21% oxygen by volume. When a sample of river water was boiled, the air expelled was found to contain 30% oxygen. What is the best explanation of this difference in oxygen content?

- A Carbon dioxide is more soluble in water than is oxygen.
- B Nitrogen reacts with water.
- C Oxygen is more soluble in water than is nitrogen.
- D The noble gases are insoluble in water.

**Question 10.**

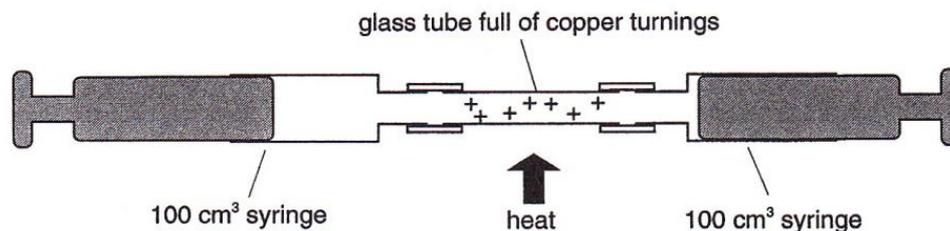
Which statements about the pollutant carbon monoxide are correct?

- 1 It is a colourless and odourless gas.
- 2 It is formed by the incomplete combustion of natural gas.
- 3 It reacts with haemoglobin in the blood.

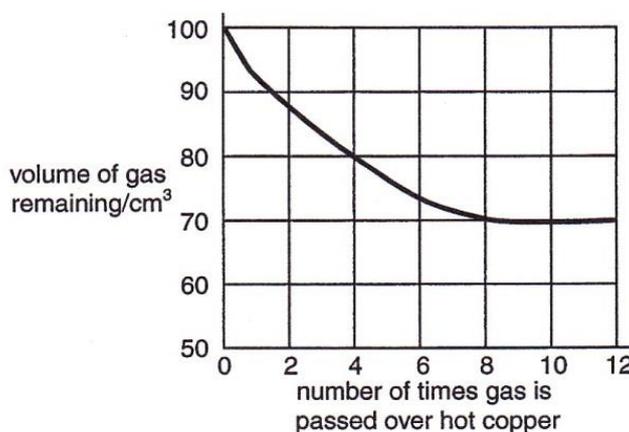
- A 1 and 2 only.
- B 1 and 3 only.
- C 2 and 3 only.
- D 1, 2 and 3.

**Question 11.**

A 100 cm<sup>3</sup> sample of bottled gas used for diving was placed in a gas syringe in the apparatus shown.



The gas was passed backward and forward over heated copper turnings. The results obtained were used to plot the graph.



What is the percentage of oxygen in the bottled gas?

- A 20%.
- B 30%.
- C 70%.
- D 80%.

**Question 12.**

Which atmospheric pollutants, emitted by internal combustion engines, are reacted together to convert them to less harmful products?

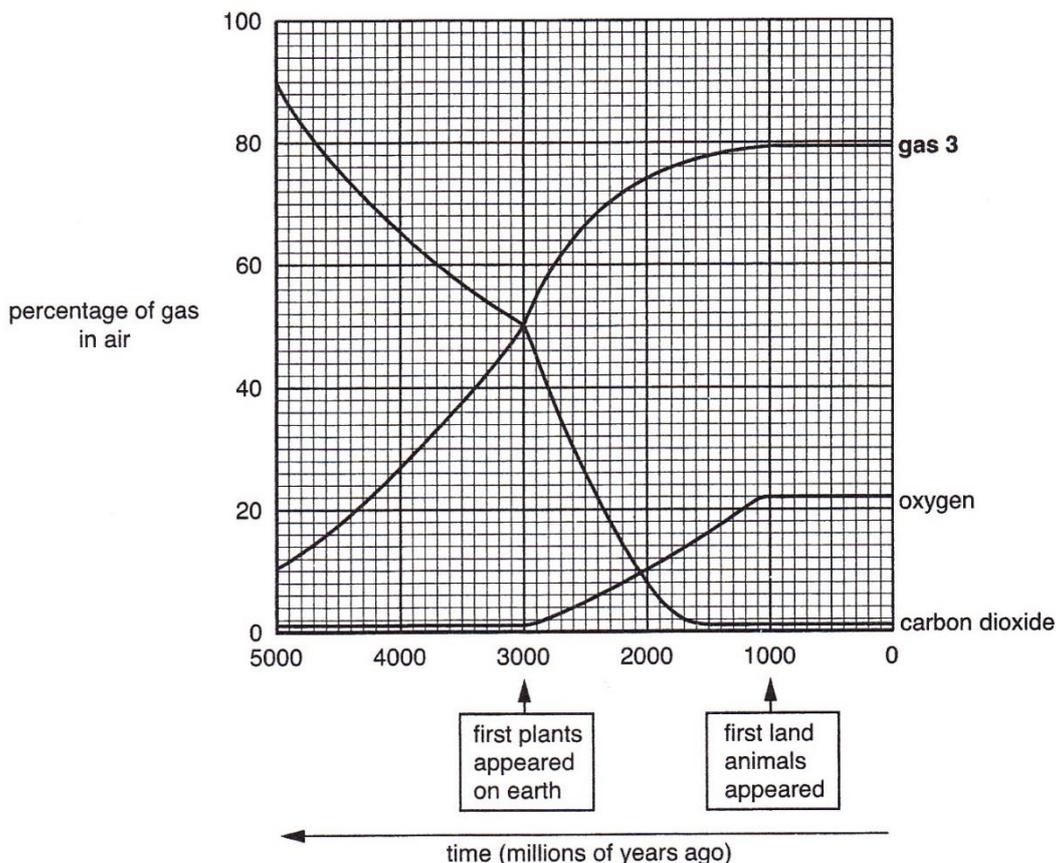
- A Carbon monoxide and nitrogen dioxide.
- B Carbon monoxide and unburned hydrocarbons.
- C Nitrogen dioxide and sulfur dioxide.
- D Sulfur dioxide and unburned hydrocarbons.

Write your answers to the 12 multiple choice questions in the table provided on the right.

1. D	2. D	3. B	4. A
5. D	6. B	7. C	8. C
9. C	10. D	11. B	12. A

### Question 13.

This graph shows how the percentage of three of the gases in the Earth's atmosphere has changed over five thousand million years.



Use the information from the graph to answer the following questions.

- a) i) How long have the percentages of all gases in the atmosphere remained unchanged?

The percentages of all gases have remained unchanged for the past 1000 million years.

- ii) Name **gas 3**. Give a reason for your answer.

Nitrogen. Nitrogen makes up 79% (78% - new syllabus) of dry air by volume.

- b) i) Describe how the percentages of carbon dioxide and oxygen have changed.

From 5000 million to 3000 million years ago, levels of carbon dioxide decreased from 90% to 50%. Since green plants appeared on Earth 3000 million years ago, levels of carbon dioxide have decreased more rapidly, reaching a constant value of approximately 1% 1500 million years ago.

From 5000 million to 3000 million years ago, the level of oxygen gas remained constant at approximately 1%. Since 3000 million years ago, when the first green plants appeared on Earth, the percentage oxygen has increased steadily until 1000 million years ago when the first land animals appeared. Since then, the percentage oxygen has remained constant at 22%.

- ii) Suggest an explanation for the changes that have taken place in carbon dioxide and oxygen percentages, identifying the processes involved and giving equations for any reactions.

In the presence of sunlight, green plants undergo photosynthesis:



Green plants take in carbon dioxide and water to produce sugars and oxygen. Since green plants appeared on the surface of the Earth 3000 million years ago, the percentage of carbon dioxide has decreased while the percentage of oxygen has increased.

Plants and animals both respire:



The process of respiration takes in sugars and oxygen to produce carbon dioxide, water and energy.

Human activities such as burning wood, coal, oil and natural gas also consume oxygen and produce carbon dioxide, e.g.



Since the time when plants and animals both lived on the Earth's surface, the processes of photosynthesis, respiration and combustion have maintained the levels of carbon dioxide and oxygen in the Earth's atmosphere at relatively constant levels.

#### Question 14.

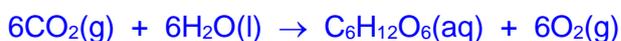
A farmer living in a tropical country grows sugar cane on his land. Once harvested, glucose in the sugar cane is fermented to produce ethanol:

glucose  $\rightarrow$  carbon dioxide + ethanol



The farmer uses the ethanol as fuel for his farm machines.

- a) Write a balanced chemical equation to show how carbon dioxide and water are converted into glucose and oxygen in the sugar cane.



- b) Write a balanced chemical equation for the complete combustion of ethanol to form carbon dioxide and water.



- c) Explain why ethanol from sugar cane is described as a "carbon neutral" fuel.

The amount of carbon dioxide removed from the atmosphere by photosynthesis (6 mol) is equal to the amount of carbon dioxide that is returned to the atmosphere by fermentation (2 mol) and combustion of ethanol (4 mol). Overall, the process does not affect the amount of carbon dioxide in the atmosphere.

**Question 15.**

Using infrared spectroscopy, astrochemists have discovered that the atmosphere of a planet 17.3 light years from Earth has the following percentage composition by volume:

Gas Present in the Planet's Atmosphere	Percentage of the Gas Present in the Planet's Atmosphere by Volume
Carbon Dioxide	18%
Carbon Monoxide	21%
Nitrogen	48%
Oxygen	12%
Argon	Approximately 1%

- a) Which gas is present in the planet's atmosphere in the same percentage that it is present in the Earth's atmosphere?

Argon.

- b) Explain why the planet's atmosphere is harmful to human health.

The planet's atmosphere is 21% carbon monoxide. Carbon monoxide is a poisonous / toxic gas that binds to haemoglobin in the blood causing headaches, fatigue and even death.

- c) The planet's atmosphere does not contain any ozone. Explain why this is both an *advantage* and a *disadvantage* to organisms that may be living on the surface of the planet.

*Advantage:* In the upper atmosphere, ozone absorbs harmful ultraviolet radiation from the sun. This reduces the incidence of skin cancer and cataracts.

*Disadvantage:* At ground level, ozone causes irritation to the eyes and respiratory system.

- d) i) If a 70.0 cm<sup>3</sup> sample of the planet's atmosphere were passed repeatedly over the surface of hot copper, what would the volume of the remaining gas be?

The 12% O<sub>2</sub>(g) is removed.  $70.0 \times (12 \div 100) = 8.40 \text{ cm}^3$ .  $70.0 - 8.40 = \underline{61.6 \text{ cm}^3}$ .

- ii) If the gas produced by the experiment in **16 d) i)** were bubbled through a concentrated solution of aqueous sodium hydroxide, what would the volume of the remaining gas be?

The 18% CO<sub>2</sub>(g) is removed.  $70.0 \times (18 \div 100) = 12.6 \text{ cm}^3$ .  $61.6 - 12.6 = \underline{49.0 \text{ cm}^3}$ .

**Note:** The volumes of all gases are measured at 25 °C and 101 000 Pa.

**Question 16.**

**a)** Briefly explain how carbon monoxide and nitrogen monoxide are formed in internal combustion engines.

**i)** Carbon monoxide:

Carbon monoxide arises from the incomplete combustion of carbon containing fuels, which takes place due to a lack of / limited supply of oxygen.

**ii)** Nitrogen monoxide:

Nitrogen monoxide is formed when nitrogen and oxygen from the air react together under conditions of high temperature and pressure inside the internal combustion engine.

**b)** Explain the problems caused by carbon monoxide and nitrogen monoxide in the environment.

**i)** Carbon monoxide:

Carbon monoxide is a poisonous gas that binds to haemoglobin in the blood. It reduces the amount of oxygen transported around the body and can cause headaches, fatigue and even death.

**ii)** Nitrogen monoxide:

Nitrogen monoxide can cause irritation to the eyes and respiratory system. It can oxidise in the atmosphere to form nitrogen dioxide which can cause acid rain. It can react with unburnt hydrocarbons in the presence of sunlight to form ozone (photochemical smog).

**c)** A catalytic converter fitted to a motor car converts carbon monoxide and nitrogen monoxide to carbon dioxide and nitrogen. Write a balanced chemical equation, including state symbols, for this reaction.

