Worksheet: Atmosphere & Greenhouse Effect

ChemistrySheets

Specification: GCSE Chemistry (AQA 5.9.1 & 5.9.2 / Edexcel SC25)

Core Concepts: The Earth's atmosphere has changed significantly over billions of years. The early atmosphere was formed by volcanic activity. The formation of oceans and the evolution of life (photosynthesis) led to the current atmosphere. Greenhouse gases absorb and re-emit infrared radiation, warming the planet in a process called the greenhouse effect.

Section A: Early Atmosphere Formation & Key Terms

1. Figure 1 illustrates key processes in the formation of the Earth's early atmosphere and oceans.

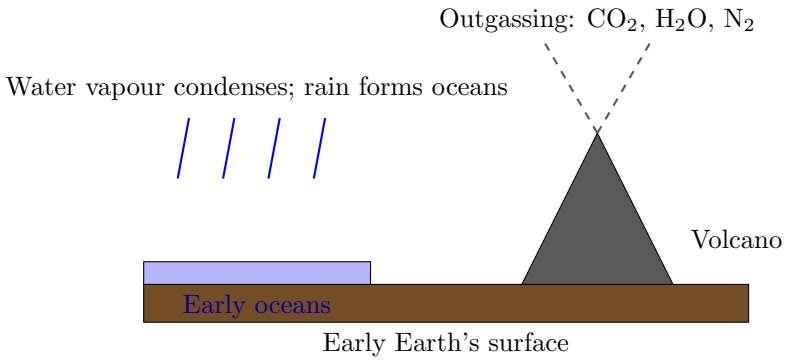

Figure 1: Formation of the Early Atmosphere and Oceans

Using Figure 1, describe two key processes that contributed to the formation of the early atmosphere and oceans.

Model Answer:
Outgassing from volcanoes released large amounts of gases like carbon dioxide, water vapour, and nitrogen, forming the early atmosphere. As the Earth cooled, water vapour condensed to form rain, which collected to form the early oceans.

2. Complete the following sentences using the most appropriate scientific terms.

a) The early atmosphere was mainly composed of **carbon dioxide** and **water vapour**, released from **volcanoes**.

b) As the Earth cooled, water vapour condensed to form **oceans**.

c) The evolution of **photosynthetic** organisms led to a significant increase in atmospheric **oxygen**.

d) Carbon dioxide dissolved in the oceans and was later locked up in **sedimentary rocks** and **fossil fuels**.

Section B: Evolution of Atmospheric Composition

1. Describe the composition of Earth's early atmosphere.

Model Answer:
The early atmosphere was primarily composed of carbon dioxide, water vapour, and nitrogen. There was very little or no oxygen present.

2. Explain how the oceans formed and their role in changing the atmosphere.

Model Answer:
As the Earth cooled, water vapour in the atmosphere condensed to form liquid water, which fell as rain and collected to form the oceans. The oceans then dissolved large amounts of carbon dioxide from the atmosphere, reducing its concentration.

3. Describe the process of photosynthesis and its impact on atmospheric composition.

Model Answer:
Photosynthesis is the process by which green plants and algae use sunlight, carbon dioxide, and water to produce glucose and oxygen. This process significantly increased the oxygen content of the atmosphere and simultaneously decreased the carbon dioxide concentration.

4. Explain the main differences between the early atmosphere and the atmosphere today.

Model Answer:
The early atmosphere was rich in carbon dioxide and water vapour, with very little oxygen. Today's atmosphere is about 78% nitrogen, 21% oxygen, and small amounts of argon, carbon dioxide, and other gases. The decrease in CO_2 and increase in O_2 are the most significant changes.

Section C: The Greenhouse Effect

1. Figure 2 illustrates the mechanism of the greenhouse effect.

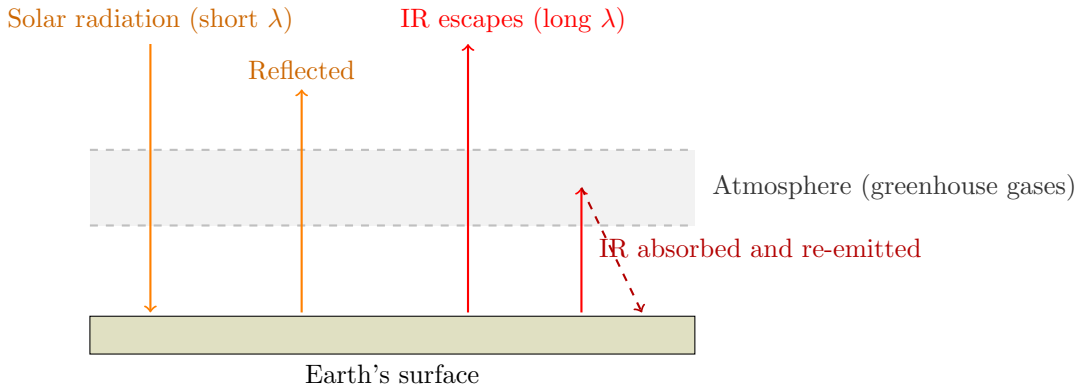

Figure 2: The Greenhouse Effect

Using Figure 2, explain how greenhouse gases contribute to the warming of the Earth's atmosphere.

Model Answer:
Greenhouse gases in the atmosphere allow short-wavelength solar radiation to pass through to the Earth's surface. The Earth then emits longer-wavelength infrared (IR) radiation. Greenhouse gases absorb this outgoing IR radiation and re-emit it in all directions, including back towards the Earth, trapping heat and warming the planet.

2. Describe the mechanism of the greenhouse effect, explaining the role of different types of radiation and how specific greenhouse gases contribute to this process. (6 marks)

Model Answer:
The greenhouse effect is a natural process that warms the Earth's surface. Short-wavelength radiation from the Sun, including visible light and ultraviolet radiation, passes through the Earth's atmosphere and is absorbed by the Earth's surface, causing it to warm up. The warmed Earth then emits longer-wavelength infrared (IR) radiation. Greenhouse gases, such as carbon dioxide, methane, and water vapour, are able to absorb this outgoing long-wavelength IR radiation. Once absorbed, these gases re-emit the IR radiation in all directions, including back towards the Earth's surface. This re-emitted radiation traps heat within the atmosphere, preventing it from escaping into space and thus warming the planet. Without this natural effect, Earth would be too cold to support life.