Stage 2 Chemistry

**Monitoring the Environment:** Global Warming and Climate Change

**Science Understanding**

* Some gases in the atmosphere, called ‘greenhouse gases’, keep the Earth’s atmosphere warmer than it would be without these gases. This is known as the ‘greenhouse effect’.
* Describe the action of the common greenhouse gases, carbon dioxide and methane, to maintain a steady temperature in the Earth’s atmosphere.
* Anthropogenic increases in greenhouse gases disrupt the thermal balance of the atmosphere.
* Explain the warming associated with global climate change and its consequences for the environment.
* Ocean acidification is caused by the ocean absorbing higher levels of carbon dioxide from the atmosphere.
* Describe and write equations to show how carbon dioxide lowers the pH of the oceans.
* Calculate the pH of solutions given the concentration of H+ or OH–, and vice versa.
* The skeletons and shells of many marine organisms are made of calcium carbonate and are vulnerable to dissolution at low pH.
* Write equations for carbonates reacting in acidic conditions.

**The Natural Greenhouse Effect**

The Earth’s surface absorbs short-wave radiation from the sun (visible light and UV rays), which is then re-emitted as long wave infra-red (IR) radiation. Some gases in the atmosphere trap part of this IR radiation, thereby warming the Earth’s atmosphere. These gases are referred to as greenhouse gases. Common greenhouse gases are CO2 and CH4 (methane). Their polar covalent bonds stretch and bend to absorb the IR radiation.

The mechanism by which these gases maintain a temperature in the Earth’s atmosphere that can support life is known as the **Natural Greenhouse Effect**.

**The Enhanced Greenhouse Effect**

Human activities affect the concentration of certain greenhouse gases and therefore have the potential to disrupt the thermal equilibrium of the atmosphere. An increase in the concentration of greenhouse gases in the atmosphere traps a greater amount of IR radiation.

The net result is that the temperature of the Earth’s atmosphere is raised. This is known as the **enhanced greenhouse effect**.

|  |  |
| --- | --- |
| **Cause** | **Effect** |
| Burning carbon based fuels |  |
| Deforestation |  |
| Agriculture, industry, waste disposal |  |

1. Burning fossil fuels causes an increase in the concentration of CO2 in the atmosphere
   1. What effect would increasing the concentration of CO2 in the atmosphere have on the absorption of IR radiation from the Earth’s surface?
   2. How has deforestation exacerbated the effect of increasing CO2 in the atmosphere
2. Water can also act as a greenhouse gas.
   1. Will the concentration of water in the atmosphere increase or decrease with a rise in global temperatures?
   2. Hence explain why the rate of change of global warming may accelerate as concentrations of CO2 in the atmosphere rise.
3. One of the concerns with global warming is rising sea levels.
   1. Melting ice caps are only a small contributor to rising sea levels. Explain why sea levels will rise with an increased global temperature.
   2. A change in global temperature and sea level will result in a change in weather patterns. Explain how this might affect the agriculture industry.
4. One of the possible ways of minimising further climate change is the capture and storage of CO2 emissions from industrial sources. Describe other ways in which climate change can be reduced in the future.

**Ocean Acidification**

As well as liquids and solids, gases can also be soluble in water. Oxygen for example is soluble in water and is vital for the survival of aquatic plants and animals.

Carbon dioxide is also soluble in water.

CO2(g) ⇌ CO2(aq)

As the concentration of carbon dioxide in the atmosphere increases, so too will the dissolved carbon dioxide content.

Carbon dioxide is a non-metal oxide. Non-metal oxides are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Write an annotated equation for the reaction of carbon dioxide with water:

**Acids and Bases review**

Acids are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Bases are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Acids ionise when dissolved in water.

Write an annotated equation for the reaction of carbonic acid with water:

pH = [H+] = note that [H+] ≡ [H3O+]

1. Calculate the pH of the following solutions
   1. 7.94 x 10-9 mol-1
   2. 3.98 x 10-7 mol-1
   3. 5.01 x 10-8 mol-1
2. Explain what will happen to the pH of the ocean as atmospheric concentrations of carbon dioxide rise
3. An acidic solution of water is titrated with a 1M standard solution of NaOH. Calculate the pH of the standard solution.

The skeletons and shells of many marine organisms are made of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Write the equation for the reaction of this chemical with acid:

1. Explain why marine organisms with shells may find it difficult to live in water with a higher dissolved carbon dioxide level.
2. With reference to the previous equation, explain why the dissolution of the organisms shells will not significantly reduce the acid content of the water