# Concrete solutions

***Education in Chemistry***September 2020  
[rsc.li/2ZyA0jZ](https://rsc.li/2ZyA0jZ)

The following questions linked to the article *Concrete solutions* need you to think back to earlier chemistry units and retrieve key knowledge.

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| **Question** | **Answer** |
| Concrete is an example of a **composite** material.  State **two** other composite materials. |  |
| The article describes how cement and therefore concrete can be produced more sustainably.  Describe what we mean when we say a process is **sustainable**. |  |
| Cement is formed by heating powdered limestone with clay.  During this process, the calcium carbonate in the limestone undergoes **thermal decomposition.**  Define what is meant by thermal decomposition. |  |
| Calcium carbonate has the formula CaCO3.  State the number of **elements** in calcium carbonate. |  |
| State the number of **atoms** in calcium carbonate. |  |
| Calcium carbonate (CaCO3)is an ionic compound.  Calcium is in group 2.  State the charge on the calcium ion in calcium carbonate. |  |
| Calculate the relative formula mass of calcium carbonate (CaCO3).  Relative atomic masses: Ca 40; C 12; O 16 |  |
| Describe the analytical test you would use to show the presence of calcium ions in a compound. |  |
| Sand is added to cement, stones and water to make concrete. A common form of sand is composed of silica.  Silica is a macromolecule. The bonding in silica is shown below:  silicon atom  oxygen atom  Use your understanding of the bonding in a macromolecule to explain why silica has a very high melting point. |  |
| Carbon dioxide is a **greenhouse gas**.  Name two other greenhouse gases. |  |
| The early atmosphere was mostly carbon dioxide. Today the atmosphere is just 0.04% carbon dioxide.  Describe **one** process that reduced the amount of carbon dioxide in the atmosphere over the last 4.5 billion years. |  |
| The percentage of carbon dioxide in the atmosphere today is slowly increasing.  State **one** way that human activity is increasing the levels of carbon dioxide in the atmosphere today. |  |
| Describe what is meant by the **carbon footprint** of a product. |  |
| Give **two** ways, described in the article, that scientists hope to reduce the carbon footprint of concrete in the future. |  |

**Answers**

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| **Question** | **Answer** |
| Concrete is an example of a **composite** material.  State **two** other composite materials. | Possible answers include:   * Fibreglass * Carbon fibre * Concrete * Wood * Reinforced concrete |
| The article describes how cement and therefore concrete can be produced more sustainably.  Describe what we mean when we say a process is **sustainable**. | Capable of being maintained at a steady level without exhausting natural resources or causing environmental or ecological damage. |
| Cement is formed by heating powdered limestone with clay.  During this process, the calcium carbonate in the limestone undergoes **thermal decomposition.**  Define what is meant by thermal decomposition. | A reaction in which one substance is broken down into two or more substances using heat. |
| Calcium carbonate has the formula CaCO3.  State the number of **elements** in calcium carbonate. | 3 elements (calcium, carbon and oxygen) |
| State the number of **atoms** in calcium carbonate | 5 atoms (1 × Ca, 1 × C and 3 × O) |
| Calcium carbonate (CaCO3) is an ionic compound.  Calcium is in group 2.  State the charge on the calcium ion in calcium carbonate. | 2+ |
| Calculate the relative formula mass of calcium carbonate (CaCO3).  Relative atomic masses: Ca 40; C 12; O 16 | 40 + 12 + (3 × 16)  = **100** |
| Describe the analytical test you would use to show the presence of calcium ions in a compound. | Flame test – heat the unknown substance in a blue Bunsen flame. A characteristic orange-red flame is observed. |

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| Sand is added to cement, stones and water to make concrete. A common form of sand is composed of silica.  Silica is a **macromolecule**. The bonding in silica is shown below:  silicon atom  oxygen atom  Use your understanding of the bonding in a macromolecule to explain why silica has a very high melting point. | To melt a macromolecule you need to break strong covalent bonds.  This requires a lot of energy. |
| Carbon dioxide is a **greenhouse gas**.  Name two other greenhouse gases. | * Methane * Water vapour |
| The early atmosphere was mostly carbon dioxide. Today the atmosphere is just 0.04% carbon dioxide.  Describe **one** process that reduced the amount of carbon dioxide in the atmosphere over the last 4.5 billion years. | Any one of:   * Once oceans had formed the carbon dioxide dissolved in the oceans. The dissolved carbon dioxide then underwent a series of reactions to form carbonate precipitates that formed sediments on the sea bed. * Green plants evolved and removed carbon dioxide through photosynthesis. * Marine animals evolved. Their shells and skeletons contained carbonates from the oceans. |
| The percentage of carbon dioxide in the atmosphere today is slowly increasing.  State **one** way that human activity is increasing the levels of carbon dioxide in the atmosphere today. | Any one of:   * Burning fossil fuels (allow any activity that involves the burning of fossil fuels) * Increased human population * Deforestation |
| Describe what is meant by the **carbon footprint** of a product. | A carbon footprint is a measure of the amount of carbon dioxide and other greenhouse gases released over the full life cycle of a product. |
| Give **two** ways, described in the article, that scientists hope to reduce the carbon footprint of concrete in the future. | Any two of:   * Add other materials that produce less CO2 to the mix, for example ground granulated blast-furnace slag (a by-product from steel production) or fly ash (a by-product from the coal industry). * Add pozzolans such as calcined clay to the concrete. * Incorporate dried, crushed wood into the cement. |