# 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 atomoxygen atomUse 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
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| 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 atomoxygen atomUse 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
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| 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.
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| 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
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| 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.
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