

The carbon footprint and its reduction

5.9.2.4 · Chemistry · revision notes

What a carbon footprint is, how it can be reduced by cutting emissions of carbon dioxide and methane, and why these actions may be limited. Expect a definition, 'describe actions' and 'give reasons why actions may be limited' questions, and data questions that compare emissions.

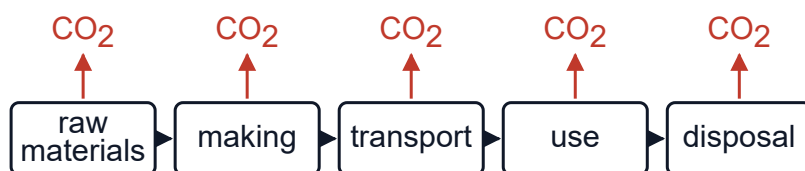
Key facts

- Carbon footprint = total CO₂ and other greenhouse gases emitted over the full life cycle of a product, service or event
- Reduce a footprint by cutting emissions of carbon dioxide and methane
- Carbon neutral = zero net release of carbon dioxide
- 1 kg = 1000 g and 1 tonne = 1000 kg
- Full life cycle: raw materials → manufacture → transport → use → disposal
- Actions: alternative energy, energy conservation, carbon capture and storage, carbon taxes and licences, carbon off-setting (e.g. tree planting), carbon neutrality
- Limits: scientific disagreement, lack of public information and education, lifestyle changes, economic considerations, incomplete international cooperation

Notes

What a carbon footprint is

- The **carbon footprint** is the **total** amount of **carbon dioxide and other greenhouse gases** emitted over the **full life cycle** of a product, service or event.
- Full life cycle means every stage: getting the raw materials, manufacturing, transport, use and disposal.



carbon footprint = total greenhouse gases from every stage

The footprint counts the whole life cycle, not just the use.

- A carbon footprint can be reduced by **reducing emissions of carbon dioxide and methane**.

Actions to reduce emissions

- **Alternative energy supplies:** more use of renewable resources (such as wind, solar and hydroelectric power) and nuclear power instead of fossil fuels.
- **Energy conservation:** using less energy, e.g. insulating buildings, using efficient appliances, and using public transport.
- **Carbon capture and storage:** carbon dioxide from power stations or factories is captured and stored deep underground, e.g. in old oil and gas fields, instead of being released.
- **Carbon taxes and licences:** making companies pay for the greenhouse gases they release, or allowing them to release only a limited amount, encourages them to emit less.
- **Carbon off-setting:** balancing emissions by paying for actions that remove carbon dioxide, such as **planting trees**, which absorb carbon dioxide by photosynthesis.
- **Carbon neutrality:** activities with **zero net release** of carbon dioxide, because any carbon dioxide released is balanced by the same amount removed or offset.
- Reducing methane: collect methane from landfill sites and burn it as a fuel, send less waste to landfill, and farm fewer livestock (e.g. by people eating less meat).

Why actions may be limited

- **Scientific disagreement** over the causes and consequences of global climate change.
- **Lack of public information and education**, so people don't know what to do or why.
- People may not want to make **lifestyle changes**, e.g. flying less or changing their diet.
- **Economic considerations:** many actions are expensive, and some countries depend on fossil fuels for jobs, income and development.
- **Incomplete international cooperation:** not every country agrees to cut emissions, and one country acting alone has a limited effect.

How to answer each type of question

Define carbon footprint

2 marks

Grade 4

1. Say it is the **TOTAL** amount of carbon dioxide and other greenhouse gases.
2. Say it is over the **FULL LIFE CYCLE** of a product, service or event.

Example. What is meant by the carbon footprint of a product?

Model answer. The total amount of carbon dioxide and other greenhouse gases emitted (1) over the full life cycle of the product (1).

Describe actions to reduce emissions

2 to 3 marks

Grade 5

1. Give different actions, not the same idea twice.
2. For each one, say how it reduces emissions (e.g. 'so less fossil fuel is burned').

Example. A school wants to reduce the carbon footprint of its buildings.
Describe **three** actions it could take.

Model answer. Any three from:

- fit solar panels, or buy electricity from renewable sources, so less fossil fuel is burned (1)
- insulate the buildings or use energy-efficient lighting, to conserve energy (1)
- plant trees to offset some of its carbon dioxide emissions (1)
- send less waste to landfill, e.g. by recycling or composting, to reduce methane emissions (1)

Don't lose marks

- ✗ Defining carbon footprint as 'the carbon dioxide from burning fuel'. It includes other greenhouse gases and the whole life cycle.
- ✗ Writing 'be more eco-friendly' or 'recycle' without saying how it reduces emissions.
- ✗ Thinking that planting trees cancels emissions straight away. Trees take years to absorb the carbon dioxide.
- ✗ Saying carbon neutral means 'releases no carbon dioxide'. It means zero NET release.
- ✗ Giving more actions when the question asks why actions may be limited.

More tips

Memory tricks

- Carbon footprint = 'cradle to grave': count every stage, from raw materials to disposal.
- Six actions: 'All Countries Could Try Offsetting Now': Alternative energy, Conservation, Capture and storage, Taxes and licences, Off-setting, Neutrality.
- Five limits: 'Some People Like Eating Ice cream': Scientific disagreement, Public information lacking, Lifestyle changes, Economic considerations, International cooperation incomplete.
- Unit check: g → kg ÷ 1000, kg → tonnes ÷ 1000.

Exam technique

- A definition of carbon footprint needs three ideas: total, carbon dioxide and other greenhouse gases, full life cycle.
- 'Give reasons why actions may be limited' wants barriers such as cost, cooperation, lifestyle, information and disagreement.
- In 'evaluate' questions, use data from the question, compare the options and finish with a justified judgement.
- Show each step of a calculation with its unit.

What each grade needs

What you need to be able to do, from the first marks up to the top grade.

Grade 3

Give one way to reduce carbon dioxide emissions

For example, generate electricity from renewable resources instead of burning fossil fuels.

Grade 4

Define carbon footprint

The total amount of carbon dioxide and other greenhouse gases emitted over the full life cycle of a product, service or event.

Grade 5

Describe actions to reduce emissions

Alternative energy, energy conservation, carbon capture and storage, carbon taxes and licences, carbon off-setting and carbon neutrality.

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