Ways of reducing the use of resources

5.10.2.2 · Chemistry · revision notes

Why reducing use, reusing and recycling materials saves limited resources and energy, how glass and metals are reused and recycled, and how to evaluate ways of reducing the use of resources from given information. Expect short explanations and data-based 'evaluate' questions on Paper 2.

Key facts

- Reduce, reuse, recycle → less use of limited resources and energy, less waste, smaller environmental impact
- Glass bottles: reuse (wash and refill) or recycle (crush and melt → different glass products)
- Scrap steel added to blast furnace iron → less iron extracted from ore
- Percentage saved = (energy for new − energy for recycled) ÷ energy for new × 100
- Limited raw materials: metals, glass, building materials, clay ceramics, most plastics
- Metals: recycled by melting and recasting or reforming
- Separation needed depends on the material and the properties of the final product

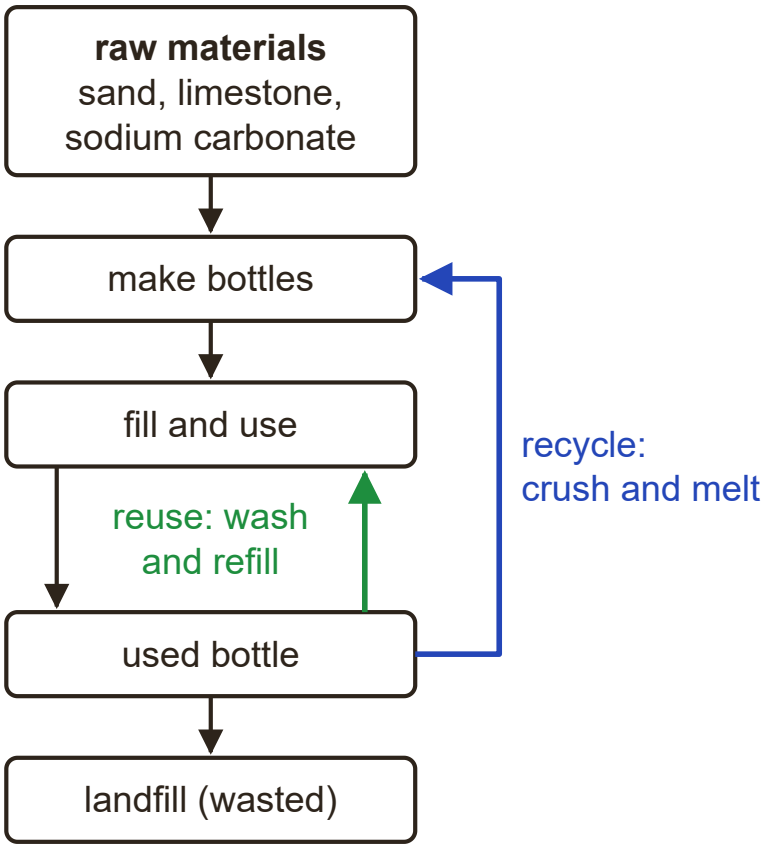
Notes

Why reduce, reuse and recycle

- Reducing use, reusing and recycling materials reduces the use of **limited resources**, the use of **energy sources**, **waste** and **environmental impacts**.
- Metals, glass, building materials, clay ceramics and most plastics are made from **limited raw materials**.
- Much of the energy used to make them comes from limited resources, such as fossil fuels.
- Obtaining raw materials by **quarrying and mining** causes environmental impacts: scarred landscapes, lost habitats, noise, dust and heavy traffic.

Reuse and recycling

- **Reuse**: some products, such as glass bottles, can be used again after washing.
- **Recycle**: products that cannot be reused are recycled for a different use. Glass bottles can be **crushed and melted** to make different glass products.



Reuse saves the most energy; recycling still needs energy to melt the glass.

- **Metals** can be recycled by **melting and recasting** or reforming them into different products.
- The amount of **separation** needed depends on the material and the properties required of the final product.
- Example: some **scrap steel** can be added to iron from a blast furnace. This reduces the amount of iron that has to be extracted from iron ore.

Evaluating recycling

- Advantages: saves limited raw materials (e.g. metal ores, sand, crude oil); usually uses less energy than extracting and processing new material; less mining and quarrying; less waste sent to landfill.
- Disadvantages: collecting, transporting and sorting use energy and cost money; some materials are hard to separate; recycled material may be lower quality.
- Metals that need a lot of energy to extract, such as aluminium (extracted by electrolysis), save the most energy when recycled.
- Reducing use and reusing usually save more than recycling, because recycling still needs energy for melting and reprocessing.

How to answer each type of question

Explain the advantages of recycling a material

2 to 4 marks | Grade 5

1. Name the limited resource saved (e.g. iron ore, sand, crude oil).
2. Say that less energy is usually needed, so less fuel is burned.
3. Add a further consequence: less mining or quarrying, less waste in landfill.
4. For 'explain two', give each advantage and then its consequence.

Example. Explain **two** advantages of recycling steel cans instead of making new steel from iron ore. (4 marks)

Model answer. Less iron ore needs to be mined (1), so this limited resource lasts longer / there is less damage to the landscape (1). Less energy is needed than for extracting iron from its ore (1), so less fossil fuel is burned and less carbon dioxide is released (1).

Calculate the energy saved by recycling

2 to 4 marks | Grade 5

1. Find the energy saved: energy for new material − energy for recycled material.
2. Divide by the energy for NEW material and multiply by 100.
3. Round as the question asks and include the % sign.

Example. Producing 1 tonne of aluminium from its ore uses 190 GJ of energy. Producing 1 tonne of aluminium from recycled cans uses 10 GJ.
(a) Calculate the percentage of energy saved by recycling. Give your answer to 2 significant figures. (3 marks)
(b) Suggest **one** reason why not all aluminium is recycled. (1 mark)

Model answer.

(a) Energy saved = 190 − 10 = 180 GJ (1); 180 ÷ 190 × 100 = 94.7 (1); = 95% to 2 significant figures (1)

(b) Any one: collecting and sorting the cans costs money and uses energy / not everyone puts cans out for recycling / some aluminium is joined to other materials that are hard to separate (1)

Evaluate ways of reducing the use of resources 4 to 6 marks **Grade 5**

1. Use the information: pick out energy, mass or cost figures and compare them.
2. Give points for and against each option.
3. Remember the hidden costs: collection, transport, washing and sorting.
4. Finish with a justified conclusion.

Example. A drinks company is deciding what to do with used glass bottles. The table shows three options.

Option	What happens	Energy used per bottle (MJ)
A	Collect, wash and refill the bottles	1.1
B	Collect, crush and melt the bottles to make new bottles	2.8
C	Make new bottles from sand, limestone and sodium carbonate	4.5

Evaluate the three options. (4 marks)

Model answer. Any four from: option A uses the least energy (1.1 MJ), less than half of B and about a quarter of C (1); A and B both save raw materials such as sand and limestone, so less quarrying is needed (1); bottles must be collected and transported back, and washing in A uses water and energy (1); chipped or broken bottles cannot be refilled, so some must still be recycled (1); C uses the most energy and uses up limited raw materials (1); conclusion: A is best for undamaged bottles, with B for damaged ones (1).

Don’t lose marks

- Mixing up reusing and recycling. Refilling a bottle is reuse; melting it down is recycling.
- Saying recycling uses no energy. Collecting, transporting, sorting and melting all need energy.
- Writing 'it's better for the environment' with no reason. Say what is saved: a named limited resource, energy or landfill space.
- In percentage questions, dividing by the recycled value instead of the original value.

More tips

Memory tricks

- Order of preference: reduce > reuse > recycle > landfill. Each step down uses more energy or wastes more.
- Reuse = same job again (refill the bottle); recycle = new product (melt the bottle down).
- Percentage saved: saving ÷ ORIGINAL × 100.
- Mining and quarrying impacts: think 'scars, dust, noise, lorries'.

Exam technique

- 'Evaluate' needs points for and against, figures from the question, and a conclusion.
- Name the specific limited resource (e.g. iron ore, sand, crude oil) rather than just 'resources'.
- Look for the hidden costs in data questions: transport, sorting and separation.

What each grade needs

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

Grade 3 — **State the three ways to reduce resource use**
Reduce use, reuse and recycle.

Grade 4 — **Name materials made from limited raw materials**
Metals, glass, building materials, clay ceramics and most plastics.

Grade 5 — **Describe how glass and metals are recycled**
Glass is crushed and melted to make different glass products; metals are melted and recast or reformed.

Grade 5 — **Explain why recycling saves resources and energy**
Less of a limited raw material is used, and usually less energy than extracting and processing new material.

Grade 5 — **Evaluate a recycling scheme from given data**
Balance the resources and energy saved against the energy and cost of collecting, transporting and sorting.

Grade 6 — **Explain why separation is needed for recycling**
The amount of separation depends on the material and the properties required of the final product.

Free notes, Full packs, practice papers and mock exams at chhetriacademy.com. Written for this site; not taken from past papers. Stuck? 1-to-1 tutoring with a free 30-minute trial lesson.