

GCSE Chemistry

Worksheet: Life cycle assessment

TIME 35 min	TOTAL 32 marks	CALCULATOR Allowed	DIFFICULTY Easy, Medium
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Topics: Life cycle assessment

NAME	CLASS	DATE
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- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Answer all questions in the spaces provided.
- In all calculations, show clearly how you work out your answer.
- The marks for questions are shown in brackets.

0 1

A life cycle assessment reports that making 1 tonne of a certain plastic releases 1.8 tonnes of carbon dioxide.

0 1 . 1

A factory makes 250 tonnes of this plastic per week.

Show that this releases about 23 000 tonnes of carbon dioxide per year.

Assume 52 weeks per year.

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.....

[2 marks]

0 2

Life cycle assessments (LCAs) are carried out to assess the environmental impact of products.

0 2 . 1

Which of these is **not** one of the stages assessed in an LCA?

Tick (✓) **one** box.

Extracting and processing raw materials

☐

Manufacturing and packaging

☐

Advertising the product

☐

Disposal at the end of its useful life

☐

[1 mark]

0 2 . 2

Give **two** things that can be measured fairly easily in an LCA.

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[2 marks]

0 2 . 3

Explain why an LCA is not a purely objective process.

.....

.....

[1 mark]

0 3

0 3 . 1

Name the four main stages assessed in a life cycle assessment.

[4 marks]

0 4

0 4 . 1

Which stage of a product's life comes immediately after 'manufacturing and packaging' in a life cycle assessment?

Tick (✓) **one** box.

Extracting and processing raw materials

☐

Use

☐

Disposal

☐

Design

☐

[1 mark]

0 5

0 5 . 1

Explain why the distance food has travelled ('food miles') is often included in a life cycle assessment of a food product, but is not necessarily the most important factor in its overall environmental impact.

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[2 marks]

0 6

Table 1 compares life cycle data for two laptop computers, each designed to last for a different number of years before being replaced.

Table 1

Laptop	Energy to manufacture in MJ	Expected lifetime in years	Energy used per year in MJ
A (budget)	1800	2	150
B (durable)	2600	5	140

0 6 . 1

Calculate the total energy used by laptop A over its full expected lifetime (manufacture and use).

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Energy = MJ

[2 marks]

0 6 . 2

Calculate the total energy used by laptop B over its full expected lifetime.

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Energy = MJ

[2 marks]

0 6 . 3

Compare the energy used per year of ownership for the two laptops, and use this to evaluate which is the more sustainable choice.

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[3 marks]

.....

0 7

Table 2 shows some life cycle assessment data for a plastic shopping bag and a paper shopping bag.

Table 2

	Plastic bag	Paper bag
Raw material	crude oil	wood from trees
Energy used to make one bag in kJ	590	1680
Mass of carbon dioxide released making one bag in g	30	80
Mass of solid waste produced making one bag in g	14	50
Biodegradable	no	yes
Typical number of uses	4	1

0 7 . 1

Calculate how many times more energy is used to make a paper bag than a plastic bag.

Give your answer to 2 significant figures.

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[2 marks]

0 7 . 2

Give **one** environmental advantage of the paper bag shown in Table 2.

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[1 mark]

0 7 . 3

Compare the environmental impacts of the two bags.
Use data from Table 2.

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[4 marks]

0 8

A company selling disposable nappies used an LCA in an advertisement. The LCA included only the use and disposal stages.

0 8 . 1

Suggest why this LCA could be misleading.

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.....

[2 marks]

0 8 . 2

Suggest who should carry out an LCA so that the results can be trusted.

.....

.....

[1 mark]

0 8 . 3

Transport and distribution are included at each stage of an LCA.
Explain why transport adds to the environmental impact of a product.

.....

.....

[1 mark]

0 8 . 4

Explain why it is difficult to give numerical values to the effects of pollutants in an LCA.

.....

.....

[1 mark]

END OF QUESTIONS

Original practice questions written to match the specification. Not produced by, affiliated with or endorsed by AQA.

Mark scheme

GCSE Chemistry · Worksheet: Life cycle assessment · 32 marks

Question 1 (2 marks)

01.1 [2 marks]

- $250 \times 1.8 = 450$ (tonnes of CO₂ per week) (1)
 - $450 \times 52 = 23\,400 \approx 23\,000$ (tonnes per year), confirming the given figure (1)
-

Question 2 (4 marks)

02.1 [1 mark]

Correct: Advertising the product

02.2 [2 marks]

- use of water (1)
- use of resources / raw materials (1)
- use of energy (sources) (1)
- production of (some) wastes (1)

Any 2 of the points above.

02.3 [1 mark]

- allocating numerical values to the effects of pollutants requires value judgements (1)
-

Question 3 (4 marks)

03.1 [4 marks]

- extracting and processing raw materials (1)
 - manufacturing and packaging (1)
 - use and operation during its lifetime (1)
 - disposal at the end of its useful life (1)
-

Question 4 (1 mark)

04.1 [1 mark]

Correct: Use

Question 5 (2 marks)

05.1 [2 marks]

- transporting food further can use more fuel and release more greenhouse gases, so food miles is a real contributing factor (1)
 - how the food was produced, e.g. energy-intensive heated greenhouses grown locally compared with efficient outdoor farming abroad, can sometimes have a bigger impact than transport distance alone, so food miles by itself can be a misleading simplification (1)
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Question 6 (7 marks)

06.1 [2 marks]

Answer: 2100 MJ

- $1800 + 150 \times 2$ (1)
 - 2100 (MJ) (1)
-

06.2 [2 marks]

Answer: 3300 MJ

- $2600 + 140 \times 5$ (1)
 - 3300 (MJ) (1)
-

06.3 [3 marks]

- laptop A: $2100 \div 2 = 1050$ MJ per year; laptop B: $3300 \div 5 = 660$ MJ per year (1)
- laptop B uses less energy per year of ownership, even though it uses more energy to manufacture, because that energy is spread over more years of use (1)
- this suggests the more durable laptop (B) is the more sustainable choice, assuming both are actually used for their full expected lifetime (1)

Notes: Allow ECF from the two previous answers.

Question 7 (7 marks)

07.1 [2 marks]

Answer: 2.8 times

- $1680 \div 590$ (1)
- 2.8 (1)

Notes: An answer of 2.8 scores 2 marks. 2.85 (not 2 significant figures) scores 1 mark.

07.2 [1 mark]

- made from a renewable resource (wood) / biodegradable (1)
-

07.3 [4 marks]

- the plastic bag uses less energy to make (590 kJ compared with 1680 kJ) (1)
- the plastic bag releases less carbon dioxide (30 g compared with 80 g) and produces less solid waste (14 g compared with 50 g) (1)
- the plastic bag is made from crude oil, a finite resource, but the paper bag is made from a renewable resource (1)
- the plastic bag is not biodegradable, so it stays in landfill / as litter for a long time and can harm wildlife (1)
- the plastic bag can be used more times (4 compared with 1), so its impact per use is even lower (1)

Any 4 of the points above.

Question 8 (5 marks)

08.1 [2 marks]

- it leaves out stages (e.g. extracting raw materials, manufacturing, transport) that may have large environmental impacts (1)
 - selective / shortened LCAs can be used to reach a pre-determined conclusion (e.g. to support advertising claims) (1)
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08.2 [1 mark]

- an independent organisation / scientists with no connection to the company (1)
-

08.3 [1 mark]

- vehicles burn fuels, releasing carbon dioxide / pollutants (and using finite resources) (1)
-

08.4 [1 mark]

- deciding how harmful different pollutants are requires value judgements / effects are difficult to measure and compare (1)
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