

14.1 Atmosphere, resources and life-cycle decisions

Name: _____ Class: _____ Date: _____

Total: 10 marks

KEY WORDS life-cycle assessment • functional unit

Objective

Atmosphere, resources and life-cycle decisions. Supported HL concept preparation; original classroom practice, not an official IB paper or assessed learner work.

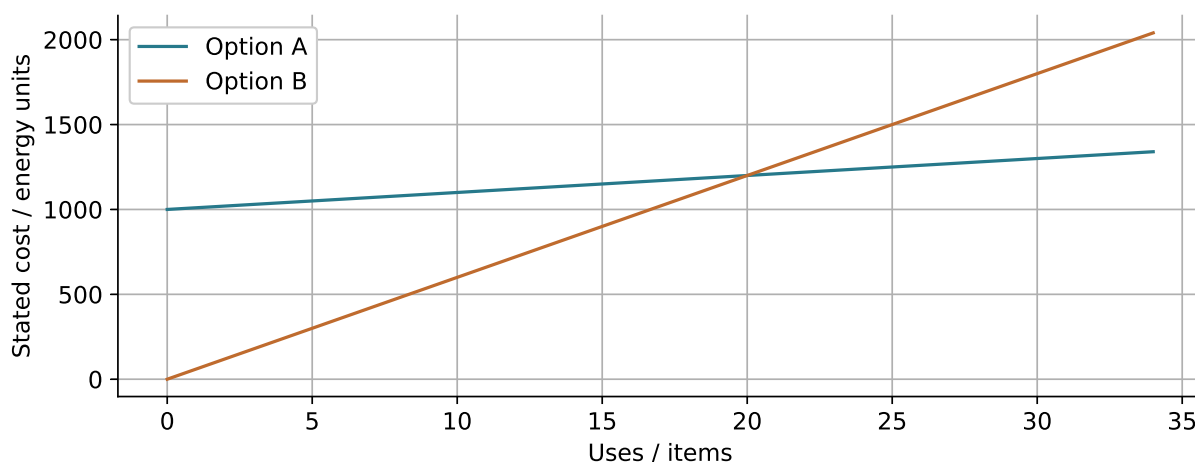
1 Key knowledge and worked examples

■ What would explain this observation?

- A reusable container can require more energy to manufacture than a single-use one. Its impact depends on how often it is used and what happens at disposal.
- Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.

■ Build the model

- A **life-cycle assessment** considers raw materials, manufacture, transport, use and end-of-life processes. Greenhouse gases absorb and emit infrared radiation; pollution and climate effects are related but distinct questions.
- life-cycle assessment: Assessment across production, use and disposal; **functional unit** : The common service used for a fair comparison.



■ Choose evidence that can test it

- Define the functional unit before comparing products. The same delivered service, such as carrying one litre of water a hundred times, is fairer than comparing one object with another regardless of lifetime.
- List system boundaries, energy sources and assumptions. Compare water demand, emissions and waste separately before making a judgement. Explain whose priorities affect the decision and where the data are uncertain.

■ Work from known quantities

- State the known values and their units. Choose the relation because its assumptions fit this case, then rearrange before substitution.
- Known: a reusable item requires 1,000 energy units to make and 10 per use; a disposable item requires 60 per use. Equality occurs when $1,000 + 10n = 60n$. Rearranging gives $1,000 = 50n$, so $n = 20$ uses under this simplified model.

Example:

A reusable item costs 600 energy units initially and 5 per use; disposables cost 35 per use. Find break-even uses. Use the same sequence: known quantities → model → relation → substitution → unit and interpretation.

■ Check the conclusion and its limits

- A break-even model is sensitive to cleaning, transport and disposal assumptions. Recyclable does not guarantee that an item is actually collected and recycled.
- Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

Warn:

A recyclable product is always recycled after use. This claim is false: A break-even model is sensitive to cleaning, transport and disposal assumptions. Recyclable does not guarantee that an item is actually collected and recycled.

Key:

Atmosphere, resources and life-cycle decisions: Define the functional unit before comparing products. The same delivered service, such as carrying one litre of water a hundred times, is fairer than comparing one object with another regardless of lifetime.

2 Practice

2.1 Which comparison uses a consistent functional unit? Choose one answer.

- **A** One bottle versus any number of bags
- **B** The same volume delivered the same number of times
- **C** Two items with the same colour

[1]

2.2 A reusable item costs 600 energy units initially and 5 per use; disposables cost 35 per use. Find break-even uses. Show the relation, substitution and units.

[2]

2.3 Decide whether this claim is true and justify: A recyclable product is always recycled after use.

[2]

2.4 Assessment across production, use and disposal: write the technical term.

[1]

3 Exam-style questions

3.1 Reusable energy is $900 + 8n$ units; disposables use $38n$. Find equality and the first whole use count at which reuse uses strictly less energy. State a missing lifecycle factor. [4]

Solutions

2.1 B Define the functional unit before comparing products. The same delivered service, such as carrying one litre of water a hundred times, is fairer than comparing one object with another regardless of lifetime.

2.2 $600 + 5n = 35n$; $600 = 30n$; $n = 20$ uses.

2.3 False. A break-even model is sensitive to cleaning, transport and disposal assumptions. Recyclable does not guarantee that an item is actually collected and recycled.

2.4 life-cycle assessment. life-cycle assessment means Assessment across production, use and disposal.

3.1 Equality $n = 30$; strictly less from 31 uses. Durability, disposal, cleaning and transport assumptions may change the comparison; energy alone is not every sustainability criterion.