

Exercise walk-through

14.1

Atmosphere, resources and life-cycle decisions

International Baccalaureate · IB Diploma · Chemistry · HL

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

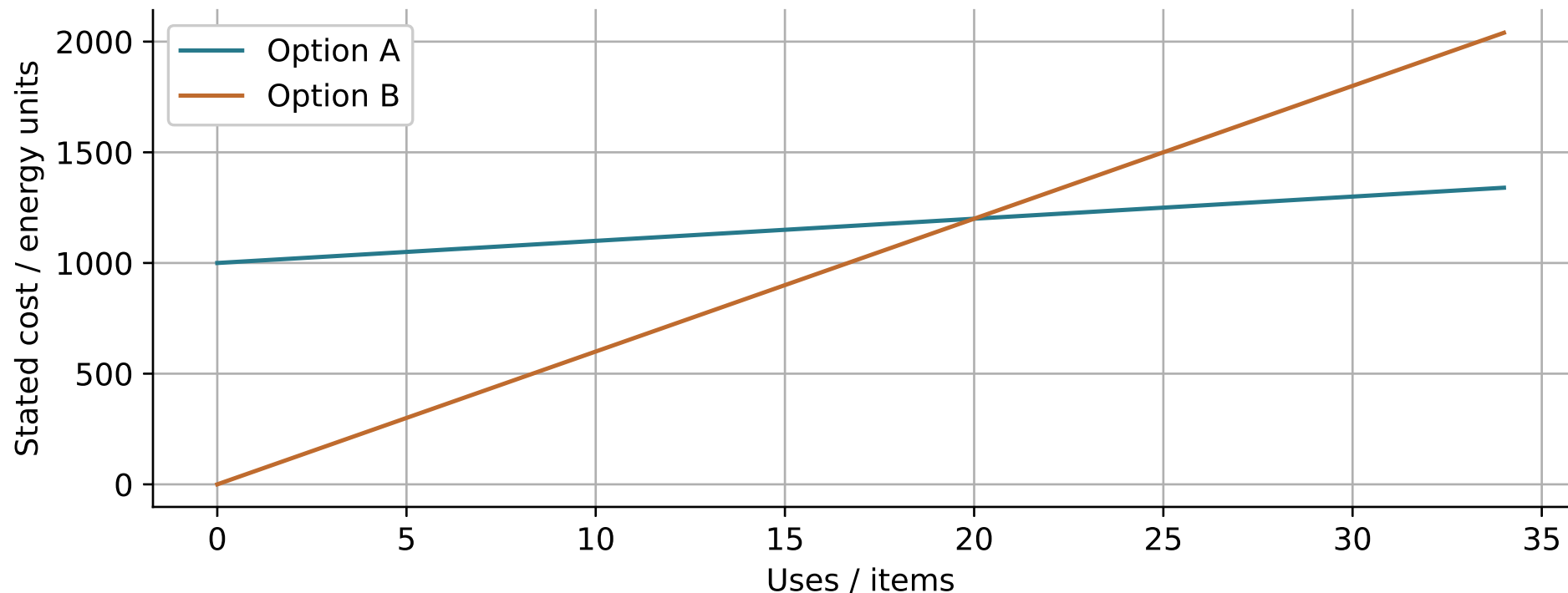
■ What would explain this observation?

- 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 $\rightarrow$ model $\rightarrow$ relation $\rightarrow$ substitution $\rightarrow$ unit and interpretation.

■ Check the conclusion and its limits

- A break-even model is sensitive to cleaning, transport and disposal assumptions. Re-

cyclable 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.

Exercises 2.1-2.3

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]

Exercises 2.1-2.3

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]

2.1 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 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]

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

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

[2]

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.

Exercises 2.4·3.1

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]

Exercises 2.4·3.1

2.4 Assessment across production, use and disposal: write the technical term. [1]

3 Exam-style questions

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

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]

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