

10.2 Life cycle assessment and recycling

Name: _____ Class: _____ Date: _____

Total: 30 marks

KEY WORDS life cycle assessment

• recycling

Objective

Carry out and critique life cycle assessments, and evaluate recycling. Original questions for spec statements 4.10.2.1–4.10.2.2.

1 Key knowledge and worked examples

LCA stages: 1) extracting and processing **raw materials**; 2) **manufacturing and packaging**; 3) **use and operation**; 4) **disposal** – transport at every stage. Energy, water, resources and waste are quantified from suitable data, with uncertainty; pollutant effects need **value judgements** – so an LCA is **not purely objective**; selective LCAs can be misused to support advertising claims.

Reduce, reuse, recycle – cuts limited-resource use, energy use, waste and mining impact. Glass bottles **reused**; glass crushed and remelted; metals **melted and recast**; **scrap steel in the blast furnace** cuts iron-ore extraction. Separation effort depends on the final product's requirements.

Worked example (3 marks). Give one advantage and one limitation of LCAs for comparing paper and plastic bags.

Advantage: comparing energy, water and waste per stage identifies which bag has the smaller resource footprint. Limitation: pollutant effects require value judgements, so the assessment is not purely objective; and a selective LCA can be biased to favour a pre-chosen conclusion.

2 Practice

2.1 List the four stages of a life cycle assessment. [4]

2.2 Why are LCA results for pollutant effects less objective than energy figures? [1]

2.3 Give one example of reuse (not recycling). [1]

3 Exam-style questions

3.1 Explain why recycling aluminium is worthwhile even though collecting it costs energy. [4]

3.2 A manufacturer claims its bags are green, citing an LCA of the disposal stage only. Evaluate the claim. [3]

3.3 Compare reuse and recycling for glass bottles, giving one benefit of each. [4]

3.4 For the same shopping task, disposable bags use 12 energy units per task. A reusable bag needs 30 units to make and 1 unit to clean per task. Find the first whole number of tasks at which the reusable bag uses less energy. Give one limitation of using this result as a complete environmental verdict. [5]

3.5 New production of a stated batch uses 50 MJ; recycling the same batch to the same quality uses 8 MJ including collection. Calculate the percentage energy saving. Explain why the phrase “recyclable” alone does not prove this saving happens. [4]

3.6 Paper bag A uses less water but more energy than plastic bag B over the same service. A seller announces A is “best for the environment” and omits its transport data. Evaluate this conclusion using two different limitations. [4]
