

GCSE Chemistry (9 – 1)

Life Cycle Assessments and Recycling

Name:

Group:

Instructions

- Read each question carefully before you begin to answer it.
- Use black ink or black ball-point pen for your answers.
- Fill in the boxes at the top of this page with your name and group.
- Attempt to answer every question in the booklet.
- Answer the questions in the spaces provided – there may be more space than you need in some answer spaces.
- Calculators may be used for this booklet.
- For any calculations, you **must** show all your working.
- Any and all drawings or graphs should be completed in pencil.



For markers use	
Question	Mark
1	/4
2	/6
3	/10
4	/8
5	/6
Total	/34
%	
Grade	

Information

- The maximum mark for this paper is 34 marks.
- The marks for each question are shown in brackets.
- Please be aware that good English and clear presentation are required in your answers.



1. To decide whether it is better to recycle a product or manufacture it from scratch, scientists use life cycle assessments or LCAs for short, to compare the energy use and pollution caused by both methods.

Circle the letter of the correct answer for each of the following questions.

- a) A life cycle assessment (LCA) looks at the environmental impact of a product.
Which stage of a product's life is **not** usually included in an LCA?

- A** Extracting and processing raw materials.
- B** Manufacturing and packaging.
- C** The cost of the product to the customer.
- D** Disposal at the end of its life.

(1 mark)

- b) Aluminium can be used to make drinks cans.

Why is recycling aluminium cans particularly important compared to recycling other materials?

- A** Aluminium is toxic if left in landfill.
- B** Extracting new aluminium from its ore (bauxite) uses a huge amount of electricity.
- C** Aluminium cannot be melted down easily.
- D** Aluminium is a rare earth metal.

(1 mark)

- c) Paper bags and plastic bags have different environmental impacts.

According to most LCAs, what is a major disadvantage of paper bags compared to plastic bags?

- A** Paper bags take much longer to decay in landfill.
- B** Paper bags are stronger and last longer.
- C** Making paper bags requires more water and energy than making plastic bags.
- D** Paper is a finite resource, whereas plastic is renewable.

(1 mark)

- d) Which of the following is a valid environmental **disadvantage** of recycling?

- A** Recycling processes produce pollution.
- B** Recycling saves energy.
- C** Recycling conserves finite resources.
- D** Recycling reduces landfill.

(1 mark)

(Total for Question 1 is 4 marks)

2. A supermarket is deciding whether to sell milk in glass bottles or plastic (polymer) bottles. The figure below shows milk in a glass bottle and a plastic bottle.



The table below shows a summary of the life cycle assessment (LCA) for both types of bottle.

Life Cycle Stage	Glass Bottle	Plastic Bottle
Raw Materials	Sand	Crude Oil
Manufacturing	Heated to 1600 °C to melt	Heated to 200 °C to mould
Transport	Heavy - high fuel use.	Lightweight - low fuel use
Disposal	Reusable many times; can be recycled	Can be recycled but often goes landfill
Biodegradable?	No	No

- a) Use the information in the table and your own knowledge to evaluate the environmental impact of both bottles and determine which bottle is better for the environment.

This image shows a full page of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page, providing a template for handwriting practice. There are no margins, text, or other markings on the paper.

(4 marks)

- b) Extracting the raw materials for the plastic bottle has a different environmental impact than extracting raw materials for the glass bottle.

State **one** environmental impact caused specifically by extracting crude oil.

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(1 marks)

- c) Some parts of a life cycle assessment (LCA) can be measured using numbers, such as the energy used. However, other parts of an LCA depend on personal opinion.

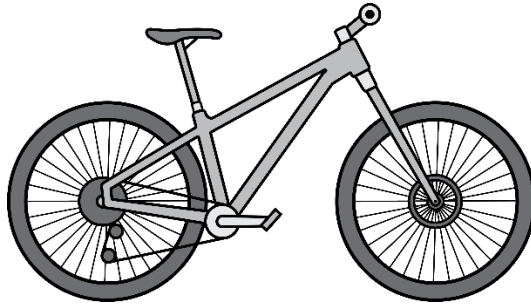
Give **one** example of an environmental impact that is difficult to measure with a number.

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(1 marks)

(Total for Question 2 is 6 marks)

3. Bicycles can be made from different materials depending on their intended use.
The figure below shows a mountain bike.



The table below shows information about two materials used to make bicycle frames: **steel** and **carbon fibre**.

	Steel	Carbon Fibre
Raw Materials	Iron ore	Crude oil
Mass of Frame	2.5 kg	1.2 kg
Relative Strength	High	Very high
Cost of Frame	£150	£2000
Disposal at end of life	Easily melted down and recycled	Difficult to recycle; usually landfill

- a) Evaluate the use of steel and carbon fibre for making bicycle frames.

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(6 marks)

The handle-bars of the bicycle are often made from aluminium.
Aluminium is a very reactive metal, yet it does not corrode easily in the rain.

- b) Explain why aluminium is resistant to corrosion.

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(2 marks)

The bicycle chain is made of steel.
Paint is a common method of rust prevention, but it is not suitable for a bicycle chain.

- c) Suggest a suitable method for protecting the chain and give one reason why it is chosen.

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(2 marks)

(Total for Question 3 is 10 marks)

4. Aluminium is a useful metal used to make drinks cans.

Aluminium is extracted from an ore called bauxite.

The table below compares the energy required to produce 1 kg of aluminium from bauxite versus recycling 1 kg of used aluminium cans.

Source of Aluminium	Energy used to produce 1 kg (MJ)
Extracted from Bauxite	280
Recycled from waste cans	14

- a) Bauxite is a finite resource.

Explain what is meant by the term '**finite resource**'.

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(1 mark)

- b) Use the data in the table to calculate the percentage of energy saved by recycling aluminium rather than extracting it from bauxite.

Show your all of your working.

Percentage energy saved = ... %

(2 marks)

- c) Describe the general process used to turn old metal cans into new metal blocks ready for manufacturing.

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(2 marks)

- d) Aside from saving energy and conserving bauxite, suggest two other environmental advantages of recycling aluminium cans.

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(2 marks)

A local council collects plastic and metal for recycling.

- e) Explain why the collected waste must be separated into different types of material before it can be processed.

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(1 mark)

(Total for Question 4 is 8 marks)

