3.2 Designing for a circular economy

Name: _____ Class: _____ Date: _____ **Total: 14 marks**

KEY WORDS circular economy • cradle to cradle • design for disassembly • durability • planned obsolescence • right to repair

Objective

Build the skills to answer exam questions on the **circular economy** : linear and circular flows, cradle to cradle, the six Rs, **design for disassembly** and durability, planned obsolescence and the right to repair.

You must be able to:

- distinguish a linear and a circular economy, and explain why inner loops (repair, reuse) save most
- apply the six Rs: rethink, refuse, reduce, reuse, repair, recycle
- describe features of design for disassembly and durability

1 Key knowledge and worked examples

Linear and circular

- **Linear economy:** take, make, use, throw away.
- **Circular economy:** keep products and materials in use as long as possible, at their highest value, and design waste out. **Cradle to cradle:** every material becomes the raw material for something new.
- The inner loops save most: **repair** keeps all the embodied energy; **recycling** saves only the material and needs energy to reprocess.

The six Rs: rethink (a better way to meet the need, e.g. a shared tool library), refuse (avoid harmful materials or packaging), reduce (less material and energy), reuse (refillable bottles), repair (spare parts and instructions), recycle (reprocess the material).

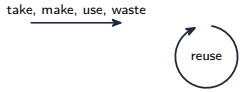
Design for disassembly and durability

- screws and clips instead of glue and welding; few, standard fasteners;
- fewer different materials, each marked (e.g. PP, ABS); no coatings that cannot be separated;
- **durability**: tough materials, protected weak points, a style that does not date quickly.

Worked example. Kettle A costs ¥120 and lasts 2 years: ¥60 per year. Kettle B costs ¥200, lasts 8 years with one ¥40 repair: $(200+40)\div 8 = ¥30$ per year. B costs more in the shop but half as much per year, and sends a quarter as many kettles to waste.

2 Practice

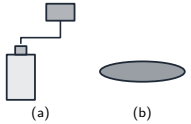
2.1 Distinguish between a **linear** and a **circular** economy. [2]



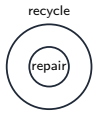
2.2 Identify which of the six Rs each action shows:

(a) a shop sells shampoo in bottles that customers bring back and refill; [1]

(b) a firm stops wrapping its cucumbers in plastic film. [1]



2.3 Explain why repairing a product saves more resources than recycling it. [2]

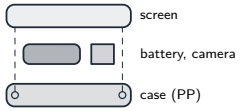


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3 Exam-style questions

3.1 FixPhone is designing a smartphone that users can repair themselves. An exploded view is shown.

(a) Outline **two** features of design for disassembly shown in the diagram. [4]



(b) Explain **one** benefit to the user and **one** benefit to the environment of a battery that users can replace. [4]

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Solutions

Marking: **M1** a correct method, **A1** the correct answer, **B1** an independent mark.

Each answer shows the steps, then the **result**.

2.1

linear: materials flow one way: take, make, use, throw away; circular: products and materials are kept in use as long as possible and waste is designed out

2.2

(a) reuse

(b) refuse

2.3

repair keeps the product and all its embodied energy in use; recycling saves only the material, and needs energy to collect and reprocess it

3.1

(a) any two, outlined: standard screws instead of glue, so parts come apart with a common screwdriver; separate modules (battery, screen, camera), so one part can be replaced without the others; parts marked with their material, so they can be sorted for recycling

(b) user: a worn battery can be replaced cheaply instead of buying a new phone; environment: the phone stays in use for longer, so its embodied energy and materials are not wasted / less e-waste

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