3.2 Designing for a circular economy

Name: _____ Class: _____ Date: _____ **Total: 30 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
- calculate the cost per year of service of two products
- explain functional, technological and style obsolescence, and right-to-repair laws

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).

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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.

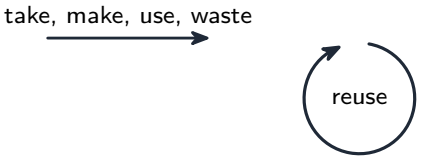
Planned obsolescence

Planned obsolescence is designing a product to become out of date or stop working sooner than needed, so people buy again: **functional** (parts wear out or cannot be replaced, e.g. glued-in batteries), **technological** (no more software updates), **style** (fashion makes it look old). It can lower prices and drive innovation, but wastes resources. **Right-to-repair** laws make firms supply spare parts and repair information (in the EU, for some appliances, up to 10 years).

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

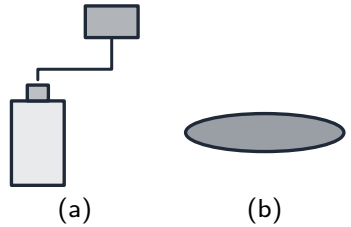
2.1 Distinguish between a **linear** and a **circular** economy. [2]



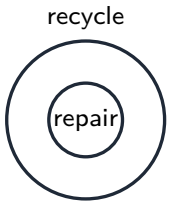
2.2 Identify which of the six Rs each action shows:

(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]

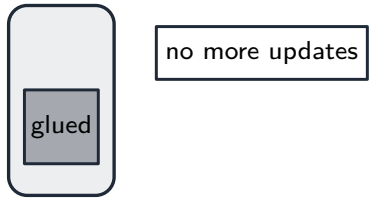


2.4 Toaster A costs ¥150 and lasts 3 years. Toaster B costs ¥320, needs one ¥40 repair and lasts 9 years. Calculate the cost per year of service of each and state which is better value. [3]



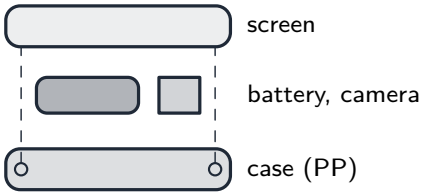
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2.5 Explain **two** kinds of planned obsolescence, with an example of each. [4]



3 Exam-style questions

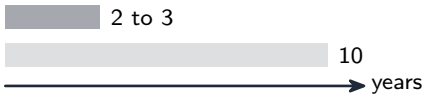
3.1 FixPhone is designing a smartphone that users can repair themselves. An exploded view is shown.



(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]

3.2 Some firms design products to be replaced every two or three years.



Discuss whether planned obsolescence can ever be justified. [9]

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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

2.4

A: $150 \div 3 =$ ¥50 per year; B: $(320 + 40) \div 9 =$ ¥40 per year; B is better value, and creates less waste

2.5

any two, explained: functional: parts wear out or cannot be replaced, e.g. a glued-in phone battery; technological: newer technology or software makes it less useful, e.g. a phone that no longer gets updates; style: fashion makes a working product look old, e.g. a new colour every year

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

3.2

award up to [9]: for: lower prices, since parts need not last long; regular sales keep firms profitable and pay for jobs; drives innovation, as users move to newer, often more efficient products; some products would be unsafe or out of date if used for too long, e.g. old safety standards; against: wastes raw materials and the embodied energy of products that still work; more e-waste, often sent to poorer countries; costs users more over time; right-to-repair laws show that society is turning against it; judgement: hard to justify for products such as phones and appliances; a better model is long-lived, repairable products with upgrades

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