Design & Technology

‘Cleaner’ design and technology- a product’s life cycle

Multiple Choice

Materials required for questions

- Pencil
- Rubber
- Calculator

Instructions

- Use black ink or ball-point pen
- Try answer all questions
- Use the space provided to answer questions
- Calculators can be used if necessary
- For the multiple choice questions, circle your answer

Advice

- Marks for each question are in brackets
- Read each question fully
- Try to answer every question
- Don’t spend too much time on one question

Good luck!

Q1. Which of the following has a positive impact on the environment?

A Inefficient work practices

B Pollution

C Reducing waste during manufacture

Q2. What type of energy is sourced from plants?

A Biomass

B Tidal

C Wind

Q3. Which one of the following vehicles would be most environmentally friendly when transporting raw material?

A Electric truck

B Plane

C Cargo boat

Q4. The definition of ‘product miles’ is which of the following?

A How far the product can go before it breaks / is thrown away

B The total distance produce is transported from the place of production to the place of use.

C The total distance the user has to travel to buy the product

Q5. Which one of the following **will not** help during the 'End of life' process?

A Design for disassembly

B Labelling of materials

C Using permanent joining techniques in design

Q6. Which one of the following **will not** help reduce energy consumption during the manufacturing process?

A Simplification of processes

B Achieving optimal use of materials

C Using biodegradable materials

Q7. Energy efficiency labels follow which rating system?

A A – G

B 1 – 10

C 1* – 5*

Q8. Disposal to landfill can cause which of following?

A Groundwater pollution

B Improved soil fertility

C Improved air quality in the surrounding area

Q9. The design and manufacture of products has an effect on our planet and environment. Analyse and evaluate the issues a consumer may consider before deciding to purchase products. Give examples in your answer. **(8 marks)**

Q10. It is said that we live in a 'throwaway' culture. Discuss the ways in which built-in product obsolescence contributes to a 'throwaway' culture. **(6 marks)**

Q11. Recycling materials plays an important role in preserving the world's natural resources. Outline how products can be designed for recycling. **(4 marks)**

Q12a. Discuss the issue of 'repair versus replacement' from a consumer's point of view. **(6 marks)**

Q12b. Explain how a company may benefit from carrying out a life cycle assessment on its products. **(4 marks)**

Q13. Give **two** was that a product can be sustainably disposed of at the end of its useful life **(2 marks)**

Q14. List **two** textile raw materials that can be considered environmentally friendly **(2 marks)**

Q15. Explain how the inclusion of smart materials in electronic products aids the end-of-life disassembly **(4 marks)**

Q16. Analyse and evaluate the environmental impact of the three packaging components listed below. **(12 marks)**

Packaging item	Material
Box	Carton board
Wrapper	LDPE film
Tray	PET

In your answer you should refer to:

- Raw materials
- Product manufacture
- Disposal/end of life.

Answers

Q1. C
Q2. A
Q3. A
Q4. B
Q5. C
Q6. C
Q7. A
Q8. A

Q9.
Expect responses to consider any of the following topics:
Raw material sourcing:

- Deforestation, e.g. damage to the rainforests and increases in CO2
- Habitat/ ecosystem destruction, e.g. Great Barrier Reef
- Mining, e.g. metal ores
- Drilling, e.g. oil production
- Farming
- Consumers may choose sustainable fibres such as organic cotton as produced without pesticides/insecticides or PET polyester as recycled plastic bottles and finite oil is not used.

Transportation:

- Mileage of product from raw material source, manufacture, distribution, user location and final disposal
- Carbon footprint – carbon produced during the manufacture and use of products

The six Rs:
(in relation to their impact on the ecology of the planet)

- RECYCLE e.g. break down a part or materials and separate into same materials and use to make a new part/product
- REDUCE e.g. use less energy, materials and resources to manufacture a product or part
- REUSE e.g. repurpose/upcycle and use for something new
- RETHINK e.g. is there a better way of manufacturing /using materials to have less of an impact on the planet etc.
- REFUSE e.g. customers choose to not buy products that are unsustainable to make/consume
- REPAIR e.g. replace a part or component when defective to extend life and delay throwing away/end of life disposal.

Pollution:

- Pollution of the oceans e.g. polymers in the ocean
- Atmospheric pollution including acid rain
- Consumers may choose unbleached/undyed cotton as no bleach or harmful dyes used

Q10.

Discussion to address the following issues:

- Once a product stops working it is thrown away
- It is often cheaper to replace a product than to repair it
- New and improved models/products are released by companies to entice new sales
- Often some of the new models are cheaper than the older models
- Replacement parts are often withdrawn by companies meaning that you cannot get spare parts
- Some parts are designed to break/wear out before other parts so the product becomes unusable
- New and developing technology and features mean people want the latest/newest products and gadgets
- Generally acceptable amongst a large section of society / lazy / lack of knowledge to fix / repair things
- Reliance on built in obsolescence to generate / perpetuate consumer cycle

Q11.

- Use materials that can be/have been recycled/use as few nonrecyclable materials as possible (1)
- Products are easy to dismantle / easy to separate different materials (1)
- Use as few different materials as possible (1)
- Use as few parts/little material as possible (1)
- Coding/marking materials so they can easily be identified (1)
- Avoid surface treatments which will need to be removed before recycling (1)
- Make products from materials which require low energy for recycling (1)

Q12a.

Positives of repair

- Product has an extended life time increasing its appeal (1)
- Less cost to repair than replace (1)
- Plentiful supply of spares (1)
- Some products are designed for consumer (DIY) repair (1)
- Some companies provide strong after-sales backup/support/repair (1)
- Some people prefer/want to stick/keep with what they have/are familiar with/sentimentality (1)
- Environmentally aware customers may prefer sustainability/avoid waste/disposal (1)
- Saved data/info (1)

Positives of replacement

- New features / upgrades / styles/trends / fashions available (1)
- Sometimes cheaper to buy new (repair difficult/expensive / time consuming/regular) (1)
- New products readily available/convenient, whereas replacement parts are not (1)
- Generally quicker to replace than repair (1)
- Reliability of a new product (1)

Q12b.

- Determine/investigate cradle to grave (mention of any stage of life) carbon footprint/energy use/environmental impact/materials used (1)
- Reduce a carbon footprint/emissions/meet emission targets/environmentally friendly (1)
- Reduce the volume / range / amount of materials required (1)
- Reduce manufacturing/material costs/waste/errors (1)
- Savings made/increased profit (1)
- Reduce the amount of energy required to manufacture /distribute the product / reduce energy costs. (1)
- Promote the product as being environmentally friendly/green/avoid fines (1)
- Setup production nearer to suppliers / markets (1)
- Reduce transportation costs (1)
- Reduce the amount of time required to manufacture the product / Improve manufacturing speed (1)
- Get the product onto the market more quickly (1)
- Predict product lifespan/failure (1)

- Plan/provide improved/longer lasting product/replacement (1)
- Choose/change materials for future products (1)

Q13.

- Separation for recycling (1)
- Segregation of waste (1)
- Reclamation/re-use of materials
- Use of licensed disposal contractors/licensed tipping facilities (1)
- Repurposing/upcycling of the product (1)
- Identification of biodegradable parts (1)

Q14.

- Cotton (1)
- Linen (1)
- Wool (1)
- Hemp (1)
- Jute (1)
- Recycled fibres (1)

Q15.

- Shape memory polymers (SMP) and shape memory alloys (SMA) are starting to be used to replace traditional polymer fixings.
- Active disassembly at the end of a product's life reduces the amount of human interaction needed at this phase of the product lifecycle.
- At the end of the product's useful life the product may be heated or exposed to an electric current. These stimuli cause a change in shape of the fixing or fastening.
- The reduction in size of the fixing or fastening or the adjustment in shape of a cantilever clip etc would allow for the fixing to become loose.
- The contraction of the SMA or SMP component would enable either partial or complete removal of the joint.
- The product may be vibrated to help separate the device into component parts.

Q16.

Box:

- carton board should be produced from FSC timber
- printed images are applied by offset lithography printing requiring the addition of inks
- printing process uses electrical energy to run printer and produces contaminants that can't be allowed into streams/rivers
- addition of foil blocking or spot varnishing adds energy consumption
- die cutting of package creates waste carton board that can be recycled but creates contaminants during ink removal
- die cutting uses electrical energy during operation
- when recycled the adhesive joining the box together adds a contaminant to the process.

LDPE film:

- sourced from a finite resource of crude oil
- the clear polymer MUST be produced from 'virgin' polymer rather than recycled to give the transparency
- the calendaring process to produce the film uses heat and pressure
- the joining of the polymer film uses heat to bond the polymer without adding an extra adhesive
- LDPE used for the wrapping is a commonly recycled thermoplastic.

PET tray:

- sourced from either crude oil or recycled polymer
- vacuum forming requires heat and electrical energy
- waste polymer is trimmed from trays and recycled for further processing
- final recycling possible due to thermoplastic
- black colouring can limit recycling possibilities due to difficulty detecting on a conveyor belt.