**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.