

Design & Technology

Edexcel GCSE

Sustainability

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. What is meant by a "carbon footprint"?

- A** The area of land that a factory is built on
- B** The total amount of carbon dioxide released by making, transporting, using and disposing of a product
- C** The number of countries that a product is sold in

Q2. Which of the following is a finite resource?

- A** Crude oil
- B** Bamboo
- C** Wool

Q3. How can 3D printing help to reduce transportation costs?

- A** 3D printed parts are always heavier than moulded parts
- B** 3D printers do not need any electricity to run
- C** A digital file can be sent and the part printed close to the customer

Q4. Which new technology would help a factory reduce the air pollution it produces?

- A** Using more diesel delivery vans
- B** Fitting filters and carbon capture systems to its chimneys
- C** Making the factory building bigger

Q5. What is meant by "design for disassembly"?

- A** Designing a product so its parts can be separated easily for repair or recycling
- B** Designing a product so that it cannot be opened by the user
- C** Designing a product to be thrown away after one use

Q6. Why is e-waste a growing problem?

- A** Electronic products are too large to be sent to landfill
- B** Electronic products are made from a single material that cannot be recycled
- C** Electronic products are replaced often and contain mixed materials that are hard to separate

Q7. Manufacturers and retailers are using new and emerging technologies to reduce their carbon footprint.

A company manufactures solar powered garden lights. The manufacturer wants to reduce its carbon footprint.

Q7a. Explain one way new and emerging technologies could be used to reduce the manufacturer's carbon footprint. **(2 marks)**

Many online and in-store retailers are introducing initiatives to improve their sustainability or reduce their carbon footprint. An example of this is a retailer using wool instead of polystyrene to insulate storage containers for frozen and chilled foods.

Q7b. Give two other examples of how retailers can improve their sustainability or reduce their carbon footprint. **(2 marks)**

1

2

Q8. A box of chocolates is sold in packaging made from a card box, a polymer tray and aluminium foil wrappers.

Explain three ways the packaging of the chocolates could be designed or manufactured in a more sustainable way. **(6 marks)**

1

2

3

Q9. Carbon dioxide is released as a result of making, transporting and using a product during its lifetime. This is called a "carbon footprint".

Analyse and evaluate what factors contribute to carbon release or "carbon footprint" from raw material source to final disposal.

Give examples in your answer.

(8 marks)

[illegible]

Answers

Q1. B

Q2. A

Q3. C

Q4. B

Q5. A

Q6. C

Q7a.

Any one explanation that references how the company can reduce their carbon footprint (1 mark) and a linked justification of that way (1 mark).

Possible points include:

- They can use renewable energy sources/maximise energy efficiency for heating/lighting/powering their factory (1), therefore reducing the demand on finite sources/reducing emissions/fumes (1)
- They can use new modern/energy efficient machinery/energy recovery systems (1) which will reduce their energy use/consumption (1)
- They can use virtual chat rooms/work rooms/video conferencing for meetings/robots for production (1) which means they will not have to travel/reducing pollution (1)
- Replacement parts could be sent to customers as electronic files to be produced in situ (1) rather than sending physical components by road/air creating pollution (1)
- Any fumes/pollution/waste generated at the factory can be cleaned/scrubbed/carbon filtered/CO2 capture (1) therefore reducing the amount of pollutants released into the atmosphere (1)
- They could use biofuels/electric vehicles (1) to help reduce emissions/fumes (1)

Q7b.

One mark for each example, two required (2 marks). Answers must be appropriate for online or in-store retailers. Possible points include:

- Bag for life
- Refills for toiletries and food/drinks
- Plastic free aisles in supermarkets

- Use of compostable plastic packaging and bags, e.g. bio bags
- Introducing re-worn and recycled clothing ranges
- Bottle return schemes for polymers and glass
- Clothing hire schemes for dresses and suits
- Source products/ingredients locally
- Use electric vehicles for deliveries
- Use solar power/wind power to run the store

Award credit for any other appropriate response.

Q8.

Any three ways explained: 1 mark for identifying a suitable point and 1 mark for explaining it (6 marks). Answers must relate to the packaging being made more sustainable during designing or manufacturing, not after use. Do not accept answers about Fairtrade, or "sustainable material"/"good for the environment" without qualification. Possible points include:

- Reduce the amount of material (1) used in the packaging to lessen the use of raw materials (1)
- Re-design the packaging (1) so that refills can be bought rather than disposing of the box (1)
- Use recycled material/pulp (1) to make the packaging, reducing the need for virgin material (1)
- Don't use single use polymers (1) which can pollute the sea/rivers/landscape/wildlife (1)
- Use alternative energy in manufacturing, such as wind/solar/tidal power (1) to reduce the production of harmful emissions (1)

Award credit for any other appropriate reason.

Q9.

Expect references to Life Cycle Assessment (LCA) and "cradle to grave" assessment. Candidates are likely to mention product miles and the CO₂ generated at all stages of a product's life. Credit responses that discuss ways of reducing the CO₂ footprint. Indicative content includes:

Raw material extraction

- Fuel and energy used to harvest, fell, mine and drill for raw materials
- Reference to use of fossil fuels, e.g. petrol, oil, diesel
- Reference to recycled or reused materials to significantly reduce the CO₂ footprint at this stage

Transport

- Fuel and energy used to transport raw materials for primary processing and conversion into standard, stock and refined forms
- Transport by trucks, trains and boats
- Recycling and reusing waste material in house
- Local sourcing of materials
- More direct travel routes, e.g. the Suez Canal for products from the Far East

Packaging, shipping and distribution

- CO₂ produced in the manufacture of both primary and secondary packaging of products
- Manufacturers are striving to reduce and simplify packaging to avoid excessive material use, as well as reducing CO₂ produced in making, using and disposing of packaging

Product use and operation

- How much energy a product uses in use, e.g. its energy efficiency rating
- Whether the product contributes to CO₂ emissions, e.g. being left on standby
- Aftercare for textile products: washing machines and driers require energy

End of life/disposal

- How much energy will be required to separate materials and components
- Whether the product can be upcycled, reducing CO₂ emissions

Accept other valid responses.

Level	Marks	Descriptor
4	7-8	A fully detailed analysis and evaluation of carbon dioxide production qualified with appropriate examples. An excellent consideration of a range of factors from material sourcing to product disposal.
3	5-6	A good analysis and evaluation of carbon dioxide production qualified with limited examples. Good consideration of factors influencing the "carbon footprint" of the chosen product.
2	3-4	Basic analysis of generic points impacting on the carbon footprint of products. No evidence of an attempt to evaluate (offer a personal judgement) on each point raised.
1	1-2	One or two simple points showing limited understanding of factors impacting on the carbon footprint of products.
0	0	No response or nothing worthy of credit.