Diploma Programme
Programme du diplôme
Programa del Diploma

Design technology
Higher level and standard level
Paper 2

Wednesday 13 November 2019 (afternoon)

1 hour 30 minutes

Candidate session number

Instructions to candidates

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Section A: answer all questions.
- Section B: answer one question.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is **[50 marks]**.

20 pages

8819 – 6203

Section A

Answer **all** questions. Answers must be written within the answer boxes provided.

1. Greenfeet publishes a sustainability progress report every year which summarizes the total environmental impact of the products it produces, see **Figure 1**.

Figure 1: Greenfeet sustainability progress report 2019

TOTAL IMPACT

Area of Impact	**%**
CO_2 footprint	39 %
Land use	4 %
Pollution (air)	28 %
Pollution (water)	6 %
Water consumption	23 %

VALUE CHAIN

Manufacturing	
• Raw materials • Production sites	46 % 4 %
Supply	
• Supplier (tier 2) • Supplier (tier 1)	12 % 7 %
Distribution	
• Wholesale • Retail • Direct	2 % 3 % 2 %
Administration	
• Staff • Offices	14 % 6 %
End of Sale	4 %

In 2018, Greenfeet launched the Vertue shoe with an upper made entirely from plastic recovered from the ocean, see **Figure 2**. In 2019, Greenfeet expected to make 1.5 million pairs of Vertue shoes from 200 tons of recovered plastic, using approximately 13 bottles per shoe.

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(Question 1 continued)

Figure 2: Greenfeet Vertue shoe

(a) (i) Greenfeet has a strategic goal to reduce water use and water pollution. State the percentage of pollution caused by water pollution. [1]

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(ii) List **two** consequences of a manufacturing process that uses large quantities of raw materials. [2]

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(b) (i) Outline how the Greenfeet Vertue shoe is an example of waste mitigation. [2]

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(Question 1 continued)

(ii) Outline **one** driver for cleaning up manufacturing. [2]

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(c) (i) Outline why sketches would be used in the development of the Greenfeet Vertue shoe. [2]

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(ii) Explain **one** physiological factor considered in shoe sole design. [3]

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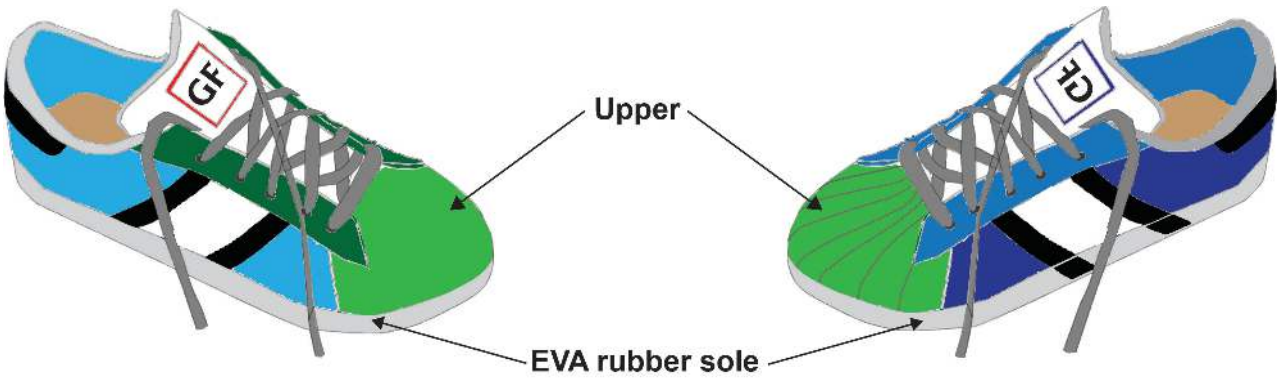
(Question 1 continued)

In 2019 Greenfeet updated its original Climeate shoe shown in **Figure 3**, with yarns made from recycled plastic waste collected from beaches. The updated shoe is shown in **Figure 4**.

Figure 3:
Greenfeet Climeate shoe (2004)

Figure 4:
Greenfeet Climeate shoe (2019)



(d) (i) List **one** characteristic that the retro-styled Greenfeet Climeate shoe (2019) shares with the original Greenfeet Climeate shoe (2004). [1]

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(ii) Outline the maximum and minimum percentiles that Greenfeet would use when manufacturing the Climeate shoe. [2]

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(Question 1 continued)

(e) (i) Describe how the EVA rubber sole of the Greenfeet Climeate shoe could be moulded. [2]

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(ii) Discuss whether the Greenfeet Climeate shoe (2019) balances the compromise between form and function. [3]

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2. Playsam creates timeless wooden toys for young children. The Playsam Streamliner Classic is manufactured from a block of wood, see **Figure 5**, and then spray painted for a glossy finish, see **Figure 6**.

Figure 5: Playsam Streamliner Classic wooden body

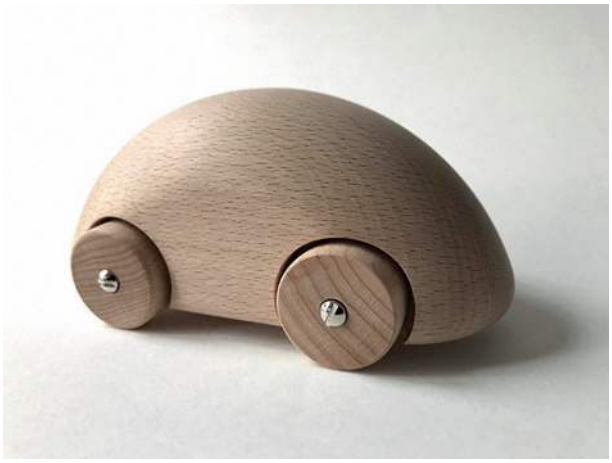
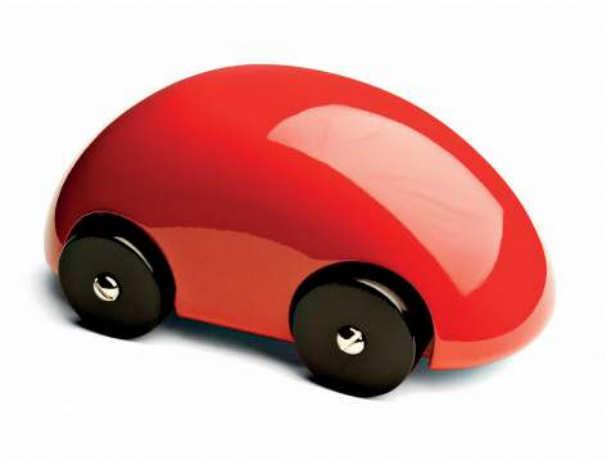


Figure 6: Playsam Streamliner Classic



[Source: with kind permission from Playsam]

(a) Describe the manufacturing process Playsam uses to create the Streamliner Classic body from a block of wood. [2]

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(b) Playsam allows customers to design their own toy car on their website by choosing the shape, colour and wheel style. Outline this production system. [2]

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will not be marked.

3. Explain **one** strategy a musician would use to protect a new song. [3]

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4. Explain **one** advantage of using second generation robots instead of first generation robots in manufacturing. [3]

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Section B

Answer **one** question. Answers must be written within the answer boxes provided.

5. Designed for, and largely operated in London, the original Routemaster buses were built between 1956 and 1968. Despite safety issues with passengers falling from the rear platform, low levels of comfort and no wheelchair access, the Routemaster outlasted newer buses intended to replace it. The Routemaster remained in use until 2005. Transport for London were seen as laggards in adopting the new Routemaster bus.

The new Routemaster, see **Figure 7**, **Figure 8** and **Figure 9**, is a hybrid diesel-electric double-decker bus operating in London. Designed by Heatherwick Studio, it is manufactured by Wrightbus, and is notable for featuring a "hop-on hop-off" rear open platform similar to the design of the AEC Routemaster, but updated to meet requirements for modern buses to be fully accessible. Following an initial order of 272 buses, the first bus entered service on 27 February 2012.

The driver's cockpit is similar to other modern buses with comfortable seating, easy access for the driver and does not obstruct passenger entry.

[Source: text adapted from https://en.wikipedia.org/wiki/New_Routemaster. Under copyright and Creative Commons licence 3.0 (https://creativecommons.org/licenses/by-sa/3.0/)]

Figure 7: A new Routemaster bus

[Source: adapted image (cropped and blurred) "LT 404 (LTZ 1404) Stagecoach London New Routemaster" by Martin49 (www.flickr.com). Under copyright and Creative Commons licence 2.0 (https://creativecommons.org/licenses/by/2.0/).]

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(Question 5 continued)

Figure 8:
Routemaster bus

Figure 9:
New Routemaster driver's cockpit

[Source: Fig 8: adapted image (blurred registration plate) "back of a new routemaster 38" by bob walker (https://www.flickr.com/photos/rjw1/8655956028/). Under copyright and creative commons licence 2.0 (https://creativecommons.org/licenses/by-sa/2.0/)
Fig 9: Autocar autocar.co.uk]

(a) List **two** characteristics of a laggard. [2]

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(b) Explain the scale of production that would be used for the new Routemaster bus. [3]

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(Question 5 continued)

(c) Explain the advantages of using virtual prototyping **and** full scale physical modelling to get feedback during the design development of the new Routemaster bus. [6]

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(Question 5 continued)

(d) Explain how the design of the driver's cockpit of the new Routemaster bus considers clearance, reach **and** adjustability. [9]

6. Some villages near Siem Reap in Cambodia have problems with waste, in this case plastic bags, polluting the landscape.

Salin and Michael of the Treak Community Centre near Siem Reap have developed an innovative way of dealing with the issue of plastic bag waste.

Plastic bags collected by the Treak community are placed on a bed of sand that is heated by a fire. This shrinks the bags and makes them stiffer. The bags are then shredded into small chunks with scissors, see **Figure 10**. The shredded plastic is then used as a substitute for aggregate in concrete which is mixed by hand, see **Figure 11**. This concrete is then moulded into bricks, see **Figure 12** and **Figure 13**, that can be used for construction.

40 % of the bricks used for the Treak Community Centre were made using this method. The remaining 60 % of bricks are standard clay construction bricks.

Figure 10:
Shredded plastic bags

Figure 11:
Shredded plastic added to concrete

Figure 12:
Concrete being moulded into bricks

Figure 13:
Completed bricks

[Sources: **Fig 10:** image “Muestra de CSR” by FerranRelea (https://commons.wikimedia.org/wiki/File:Muestra_de_CSR.JPG). Under copyright and creative commons licence 3.0 (https://creativecommons.org/licenses/by-sa/3.0/deed.en);
Fig 11–13: author’s own images]

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(Question 6 continued)

(a) Outline why these bricks are an example of a composite material. [2]

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(b) Explain why prototypes would be used in the testing and evaluation of the brick made by the Treak community. [3]

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(Question 6 continued)

(c) Designers use specifications to guide development and evaluation. Suggest the cost constraints **and** material requirements for the Treak Village plastic brick. [6]

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(Question 6 continued)

(d) Explain how the manufacture of the Treak Village plastic brick addresses the green design objectives of materials, energy **and** waste. [9]

7. Zuperzozial is a Dutch company that manufactures a range of kitchenware (plates, cups, serving utensils, and vessels) from biodegradable bamboo and corn, see **Figure 14**.

Figure 14: Assorted pieces of Zuperzozial kitchenware

[Source: with kind permission from Capventure BV, Zuperzozial]

The environmentally conscious kitchenware is stylish and durable. It also has a similar weight, feel, performance and dimensions to existing ceramic products. Zuperzozial are distributing their product through specialist kitchen stores, where they are displayed alongside conventional kitchenware. Zuperzozial needs to sell the kitchenware at a slightly higher cost than conventional kitchenware to recover the cost of the new technology used to manufacture using bamboo and corn.

(a) Outline **one** psychological factor the Zuperzozial kitchenware's designers need to consider. [2]

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(Question 7 continued)

(b) Explain **one** physical property that the material used in the Zuperzozial kitchenware needs to possess. [3]

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(c) Explain **one** advantage of using Finite element analysis (FEA) and **one** advantage of using physical models for testing the Zuperzozial kitchenware. [6]

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(Question 7 continued)

(d) Explain how Rogers' characteristics of relative advantage, compatibility **and** observability help in the diffusion of the Zuperzozial kitchenware. [9]