Diploma Programme
Programme du diplôme
Programa del Diploma

Design technology
Higher level and standard level
Paper 2

2 November 2023

Zone A morning | **Zone B** morning | **Zone C** morning

Candidate session number

1 hour 30 minutes

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]**.

8823 – 6203

19 pages

Section A

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

1. The Nokia 3310 mobile (cell) phone is considered a classic design, see **Figure 1**. It was released in the year 2000 and sold over 100 million units. The phone has a reputation for being extremely durable, with internet memes highlighting the phone as unbreakable.

In 2017 an updated version of the Nokia 3310 was released, see **Figure 2**. The phone comes without the features of many modern smartphones.

Figure 1: Original Nokia 3310 classic design

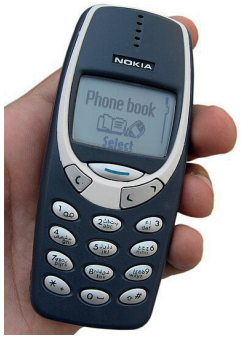

Figure 2: Updated Nokia 3310

(a) (i) State **one** piece of anthropometric data required in the design of the Nokia 3310. [1]

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(ii) Outline **one** characteristic of the Original Nokia 3310 in **Figure 1** that makes it a classic design. [2]

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(Question 1 continued)

(b) (i) Describe how retro-styling was used in the design of the updated Nokia 3310 in **Figure 2**. [2]

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(ii) List **two** drivers for mobile (cell) phone manufacturers to implement green design. [2]

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(c) (i) The original Nokia phones were designed for disassembly.

Outline how design for disassembly extended the lifespan of Nokia phones. [2]

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(ii) Explain how finite element analysis (FEA) testing can help mobile (cell) phone manufacturers develop durable products. [3]

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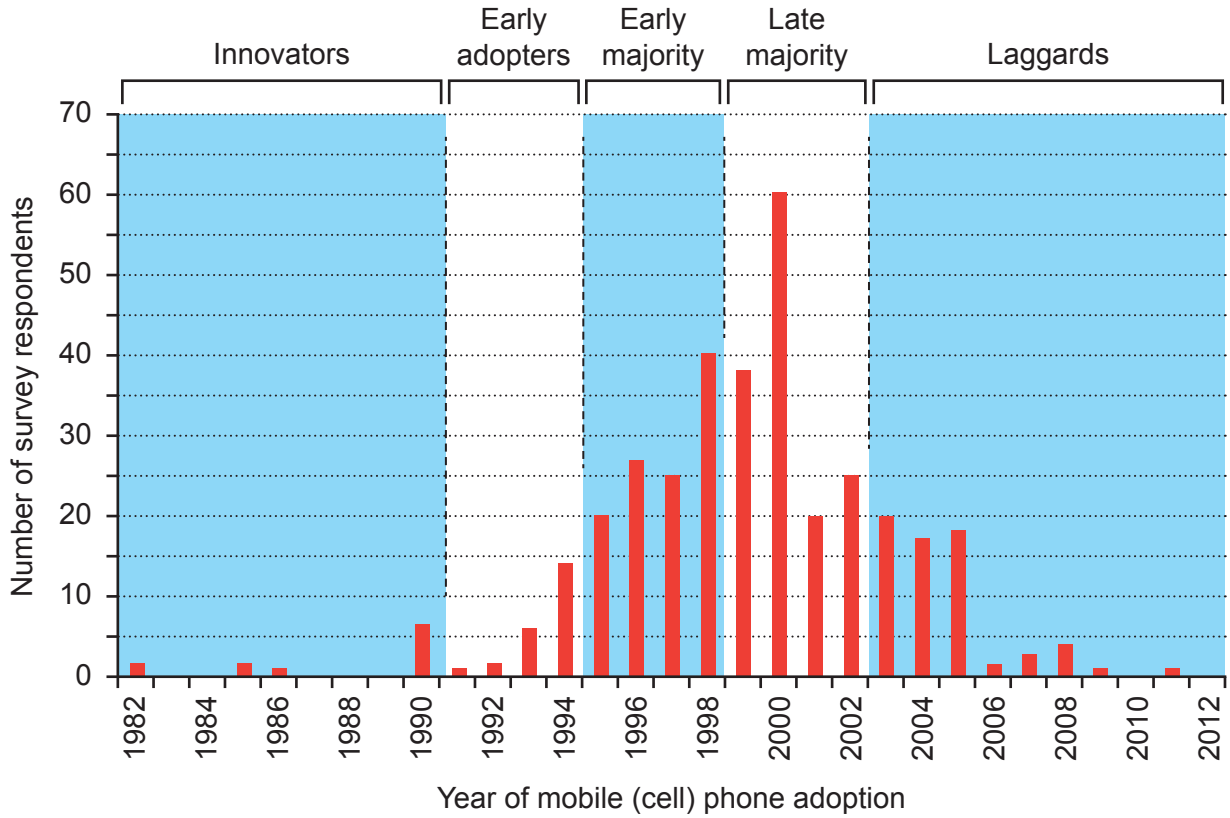
(Question 1 continued)

Figure 3 shows the respondents to a survey of mobile (cell) phone users identifying the year they adopted the mobile (cell) phone. This data was used to place phone users in one of Rogers five categories of consumer see **Figure 3**.

Figure 3: Survey of mobile (cell) phone users identifying the year they adopted the mobile (cell) phone and the category of consumer



(d) (i) State the category of consumer that adopted the original Nokia 3310 in 2000. [1]

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(ii) Calculate the total number of survey respondents who adopted a mobile (cell) phone between 1982 and 1990. [2]

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(Question 1 continued)

(e) (i) List **two** characteristics of laggards. [2]

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(ii) Explain how sustaining innovation applies to the design of mobile (cell) phones. [3]

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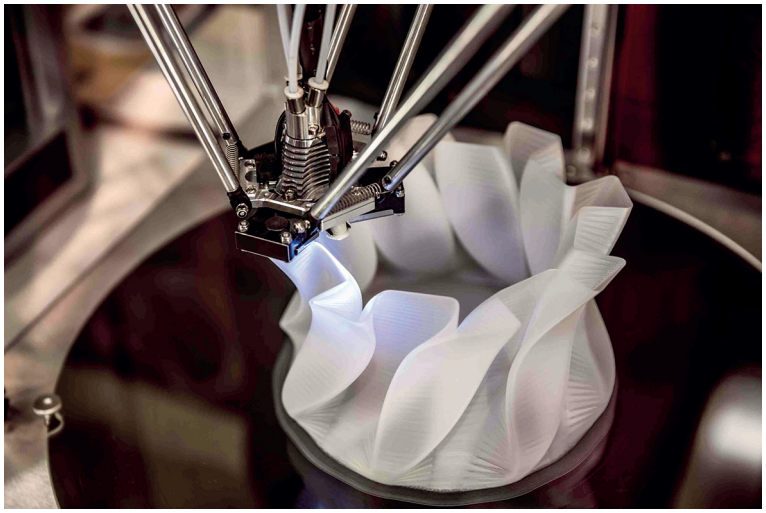
2. 4D printing allows for the printing of structures using smart materials. **Figure 4** shows an example of a structure being 4D printed by fused deposition modelling (FDM).

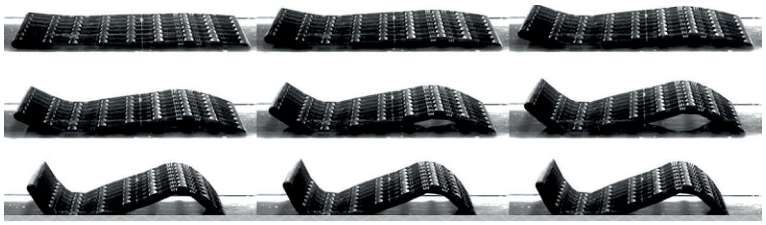
These structures change shape when exposed to heat or an electric current, see **Figure 5**.

Figure 4: 4D printing using FDM



[Source: Andrei Armiagov / Shutterstock.com]

Figure 5: A structure changing shape



(a) Describe fused deposition modelling (FDM). [2]

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(b) List **two** properties of smart materials that enable 4D printed structures to change shape. [2]

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3. Explain why many new innovations result from technology push. [3]

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4. Explain how converging technologies contribute to eco-design. [3]

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Section B

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

5. Project Olympus is a space-based construction system to support future expeditions to the moon. The project is a collaboration between space architecture specialists and robotic manufacturing specialists.

One component of Project Olympus is the Lunar Lantern structures shown in the virtual prototype, see **Figure 6,** and the scale drawing, see **Figure 7**.

The structures are designed to be 3D printed using the lunar soil as the building material, see **Figure 8**. The structures are constructed by third generation robots that are able to multi-task.

The environmental factors of the interior of the Lunar Lantern need to be carefully controlled to imitate natural conditions on earth, see **Figure 9**.

Figure 6: Virtual prototype of the Lunar Lantern

Figure 7: Scale drawing of the Lunar Lantern

Figure 8: A third generation multi-task robot constructing the Lunar Lantern

Figure 9: Digital humans inside the Lunar Lantern

(This question continues on the following page)

(Question 5 continued)

(a) Outline why Project Olympus requires a multidisciplinary approach. [2]

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(b) Explain **one** reason why the environmental factors of the interior of the Lunar Lantern need to be carefully controlled. [3]

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(Question 5 continued)

(c) Explain **one** advantage of using third generation robots and **one** advantage of using multi-task robots for construction of a Lunar Lantern on the moon. [6]

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(Question 5 continued)

(d) Explain how virtual prototypes, scale drawings **and** digital humans would be used in the development of the Lunar Lantern. [9]

6. The Roly Poly chair was designed and developed by Faye Toogood using physical scale models, see **Figure 10**. The finished product is moulded from fibreglass, see **Figure 11**. A further version of the chair has been manufactured from a form of toughened (tempered) glass, see **Figure 12**.

The chair is inspired by Toogood's experience of pregnancy and motherhood. The chair is designed with the safety of young children in mind.

Figure 10: Physical scale model of the Roly Poly chair

Figure 11: Finished product made from fibreglass

Figure 12: Additional Roly Poly chair made from a form of toughened glass

(This question continues on the following page)

(Question 6 continued)

(a) Describe the moulding process used to shape the fibreglass composite chair. [2]

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(b) Explain **one** reason why a physical scale model would be used in the development of the Roly Poly Chair. [3]

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(Question 6 continued)

(c) Explain the psychological function **and** the practical function of the Roly Poly chair. [6]

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(Question 6 continued)

(d) Explain how the mechanical properties, physical properties **and** aesthetic characteristics of toughened glass make it suitable for the Roly Poly chair. [9]

7. Pump bottles are a form of packaging designed for the easy dispensing of liquids such as shower gel and shampoo, see **Figure 13**. Most pump bottles are made from a range of different materials, see **Figure 14**.

AptarGroup developed the Future Pump Bottle made only from polyethylene (PE), see **Figure 15**. The design of the Future Pump Bottle is Patent Pending.

Figure 13: A typical pump bottle dispensing liquid

Figure 14: A pump bottle made from six different materials

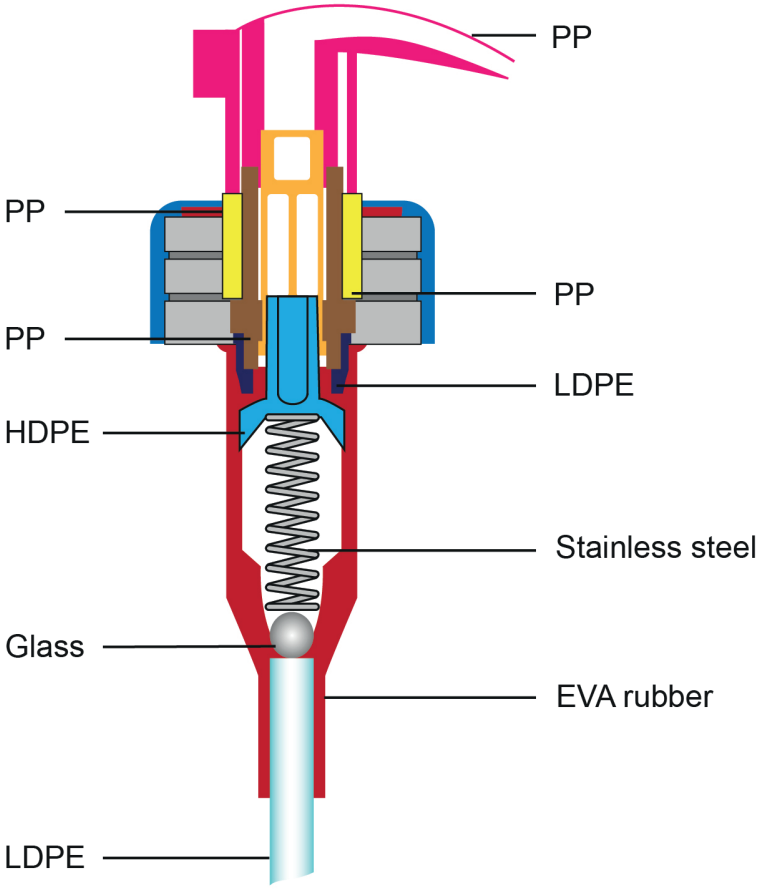

Figure 15: Future Pump bottle

(This question continues on the following page)

(Question 7 continued)

(a) (i) State the process used to manufacture the screw cap of the Future Pump Bottle. [1]

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(ii) State the process used to manufacture the body of the Future Pump Bottle. [1]

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(b) Explain why the Future Pump is patent pending? [3]

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(Question 7 continued)

(c) Explain **two** ways in which biomechanical data may have informed the design of the Future Pump bottle. [6]

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(Question 7 continued)

(d) Explain how the design of the Future Pump bottle enables a reduction of energy consumption at the pre-production, production **and** disposal stages of the life cycle. [9]

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References:

Figure 1 Asimzb. https://commons.wikimedia.org/wiki/File:Nokia_3310_in_hand.jpg. Licensed under CC BY-SA 3.0 DEED https://creativecommons.org/licenses/by-sa/3.0/deed.en/. Image adapted.

Figure 2 Kārlis Dambrāns. https://www.flickr.com/photos/janitors/38332701011. Licensed under CC BY 2.0 DEED https://creativecommons.org/licenses/by/2.0/. Image adapted.

Figure 3 Planing, P., 2015. Measuring consumer innovativeness: An empirical re-evaluation of Roger's Innovativeness Scale. *International Journal of Sales Retailing and Marketing*, [e-journal graph] Available at: https://www.researchgate.net/publication/273445085_Measuring_consumer_innovativeness_An_empirical_re-evaluation_of_Roger's_Innovativeness_Scale [Accessed 07 July 2022]. Source adapted.

Figure 4 Andrei Armiagov / Shutterstock.com.

Figure 5 With permission from MIT Self-Assembly Lab.

Figure 10 With permission from Toogood.

Figure 11 With permission from Toogood.

Figure 12 With permission from Toogood.

Figure 13 insjoy, n.d. *Washing hands isolated on white background.* [image online] Available at: https://www.gettyimages.co.uk/detail/photo/washing-hands-isolated-on-white-background-asian-royalty-free-image/1218562330?adppopup=true [Accessed 07 July 2022].

Figure 15 With permission from Aptar.

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