Diploma Programme
Programme du diplôme
Programa del Diploma

Design technology
Higher level and standard level
Paper 2

16 May 2025

Zone A afternoon | **Zone B** afternoon | **Zone C** afternoon

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]**.

2225 – 6507

29 pages

Section A

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

1. Petit Pli© was founded in 2017 by aeronautical engineer and designer, Ryan Mario Yasin who invents and applies groundbreaking material technologies to solve problems for individuals, businesses and the planet.

With the goal of addressing sustainable fashion consumption Yasin directed his attention towards children as the primary demographic. This prompted him to adopt the idea of single-size clothing aiming to meet the needs of a diverse population.

Petit Pli© has ingeniously designed a waterproof shell suit that allows for growth accommodating up to seven size categories due to the feature of multiple pleats and creases constructed within the fabric, see **Figure 1.**

The size range was categorised by considering both the ergonomic data and mechanical stretch of the clothing items ensuring a proper fit for children as they continue to grow (**Figure 2**). With the most rapid physical development stage occurring within a child's early years, particularly the first 24 months, Petit Pli© has classified its sizing into three categories: TinyHuman, MiniHuman, and LittleHuman.

Figure 1: Petit Pli©'s shell suit

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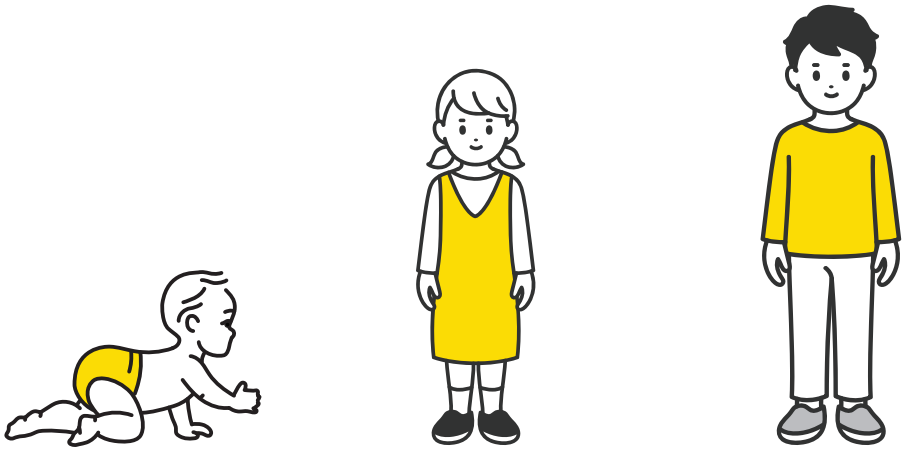
(Question 1 continued)

Figure 2: Petit Pli© sizing categories



TinyHuman
(for 0–1 years old)

MiniHuman
(for 1–4 years old)

LittleHuman
(for 4–9-years old)

Petit Pli©'s shrink and grow technology allows the garments to vary in size and is inspired by Yasin's research into satellite panels that incorporate an origami style folding structure, see **Figure 3**.

Figure 3: Petit Pli©'s expanding fabric and a folding satellite

Each garment is made using at least six recycled (PET) plastic bottles. The plastic is turned into a yarn and woven into a strong fabric. Yasin has also created a free of charge "repair programme" to extend the life of the clothes.

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(Question 1 continued)

(a) (i) List **one** driver for invention that motivated Yasin to create Petit Pli©'s waterproof shell suit (**Figure 1**). [1]

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(ii) Outline why adaptation is the strategy for innovation used by Petit Pli©. [2]

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(b) (i) List **two** types of synthetic fabric that can be converted from (PET) plastic bottles into fibres and yarn to provide the woven material for Petit Pli© garments. [2]

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(ii) Outline **one** advantage of using synthetic fibres over natural fibres in Petit Pli©'s fashion and textile design. [2]

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(Question 1 continued)

(c) (i) Outline **one** anthropometric consideration for the collection of ergonomic data when establishing Petit Pli©'s three different size categories (**Figure 2**). [2]

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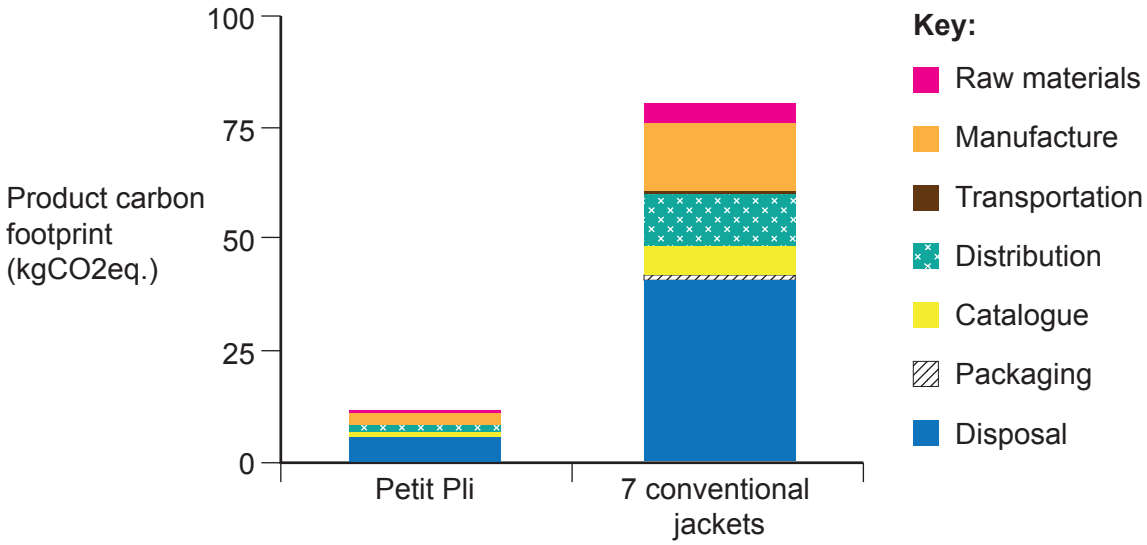
(Question 1 continued)

(ii) The following table (**Figure 4**) shows the carbon footprint emissions from the manufacture of seven conventional jackets compared to one Petit Pli© garment.

The disposal of seven conventional jackets contributes 40 kg of carbon dioxide (CO_2) emissions. All emissions categories are reduced proportionally.

Figure 4: Carbon footprint emissions of Petit Pli© jacket production verses conventional jacket manufacture for the same age range



Using the table shown in **Figure 4**, determine the percentage reduction of emissions for the disposal of one Petit Pli© garment. [3]

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(Question 1 continued)

(d) (i) State which **one** of the product life cycle stages is extended by the repair programme offered by Petit Pli©? [1]

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(ii) Identify the green design principle that Petit Pli© are aspiring to by designing clothing that extends the life of the product. [2]

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(e) (i) List **two** methods of disposal that negatively affect the environment when (PET) bottles are disposed of and are not recovered and recycled. [2]

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(ii) Explain how Petit Pli© uses a "cradle-to-cradle" approach regarding the manufacture of their garments. [3]

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2. The OMIT© handheld vacuum cleaner was created by Hiroyuki Morita. The device operates entirely through mechanical action, without any reliance on electrical energy (as shown in **Figure 5a** and **Figure 5b**). Despite its reduced power compared to a typical vacuum cleaner, the OMIT© operates silently and does not require an electric power source despite its limited operational duration.

Figure 5a and 5b: OMIT© vacuum cleaner prototype

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(Question 2 continued)

The OMIT© vacuum cleaner's internal mechanism uses planetary gears, torque springs and a needle bearing to function (**Figure 6a**).

Figure 6a: Prototype inner workings of OMIT© vacuum cleaner

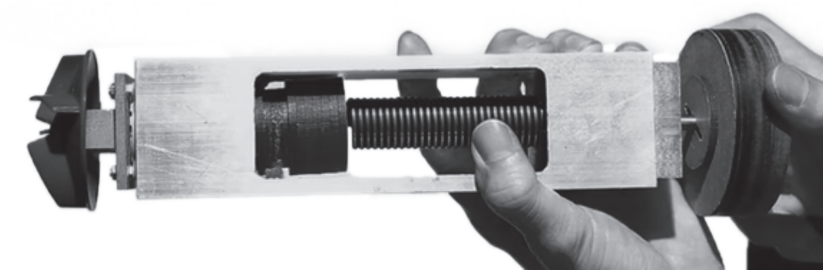
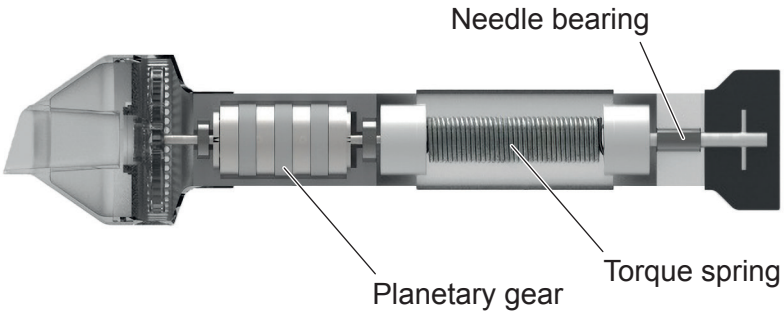
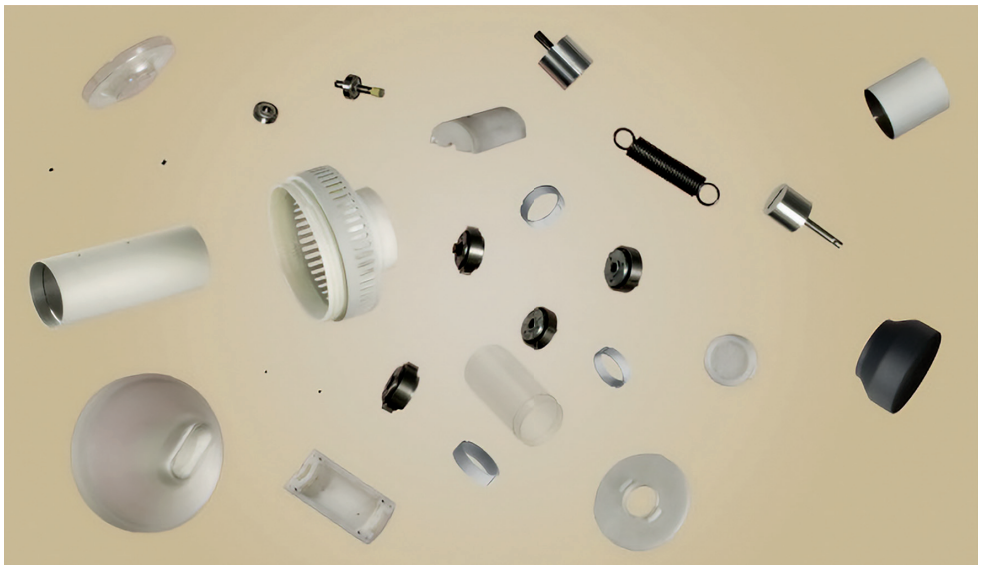


Figure 6b: Cross sectional view of the OMIT© vacuum cleaner



The early prototypes (**Figure 6a**) were made using standard components and developed with parts from other handheld vacuum cleaners to achieve the final iteration (**Figure 6b**).

Figure 7: Disassembled component parts of the OMIT© vacuum cleaner prototype



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(Question 2 continued)

(a) Identify the type of computer-generated model used to present the cross-sectional view of the OMIT© vacuum cleaner in **Figure 6b.** [2]

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(b) Outline **one** advantage of creating a prototype of the OMIT© vacuum cleaner. [2]

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3. Explain the advantages of Hiroyuki Morita using a design for assembly approach to build his early prototypes. [3]

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4. Explain why the OMIT© handheld vacuum cleaner is unlikely to become a dominant design. [3]

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Section B

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

5. The Utility Barrow (**Figures 8–10**) was designed as a multipurpose personal watercraft for regions that experience sudden and intense flooding. The Utility Barrow can be used to transport items, as a vendor cart or more importantly to provide safe passage as an evacuation vessel during floods.

The watertight enclosed body (hull) of the Utility Barrow is manufactured by rotational moulding allowing the design to be optimized for different needs. Its interior was designed to accommodate a person sitting comfortably whilst the base was kept hollow to provide buoyancy and stability on the water.

Designers of the Utility Barrow used orthographic drawings, prototypes and computer-aided design (CAD) modelling to develop, test and refine the prototypes for optimal production. As selling direct to the user is not feasible the designers aim to partner with an international aid agency to provide the Utility Barrow to communities at risk of flooding.

Figure 8: The Utility Barrow in use

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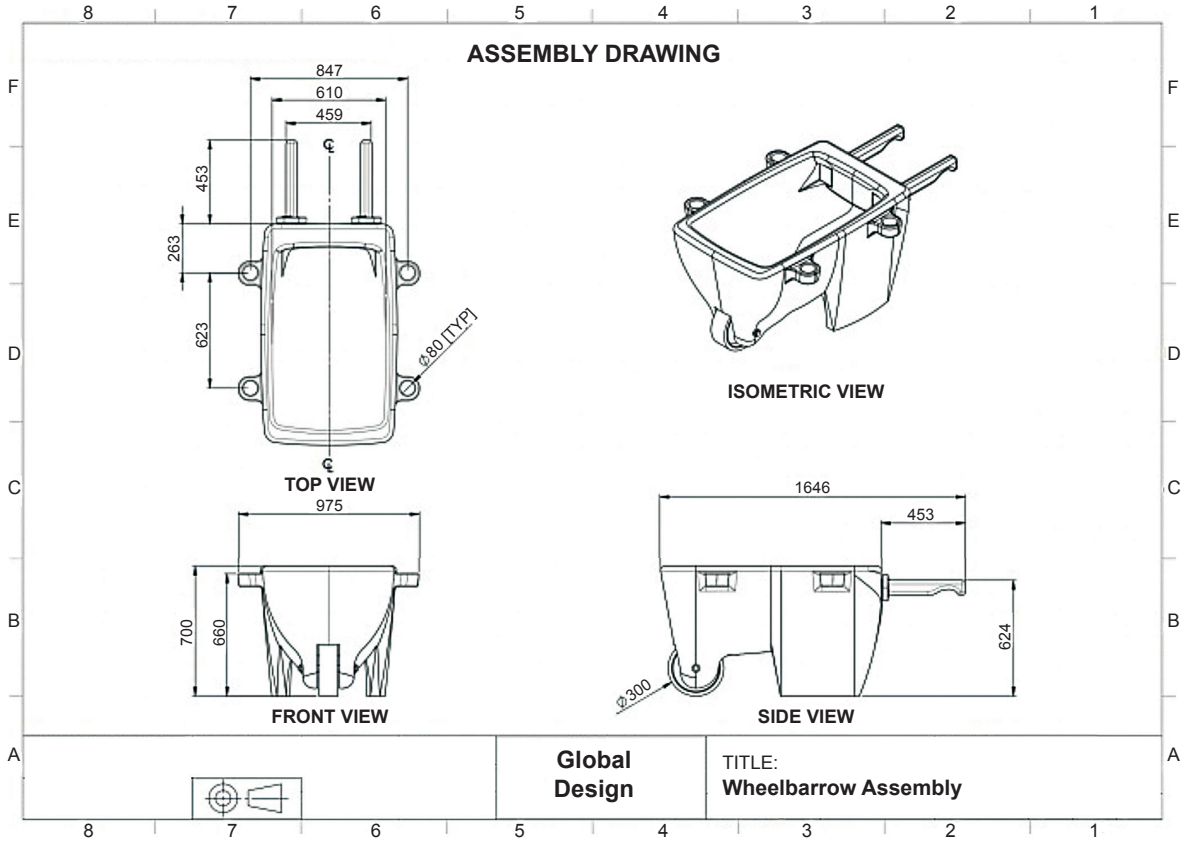
(Question 5 continued)

Figure 9: CAD model of the Utility Barrow

Figure 10: Orthographic drawing of the Utility Barrow



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(Question 5 continued)

Figure 11: Cardboard prototype of the Utility Barrow

(a) The Utility Barrow has been manufactured using rotational moulding.

List **two** other methods by which plastic products can be moulded. [2]

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(Question 5 continued)

(b) Explain how percentile ranges were used to determine the interior dimensions of the Utility Barrow to comfortably seat a human when used as a watercraft. [3]

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(Question 5 continued)

(c) Explain how the "Target Market" **and** "User Needs" were determined by the designers of the Utility Barrow as an adaptable and functional product. [6]

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(Question 5 continued)

(d) Explain why the designers used the following processes to aid in the design development of the Utility Barrow:

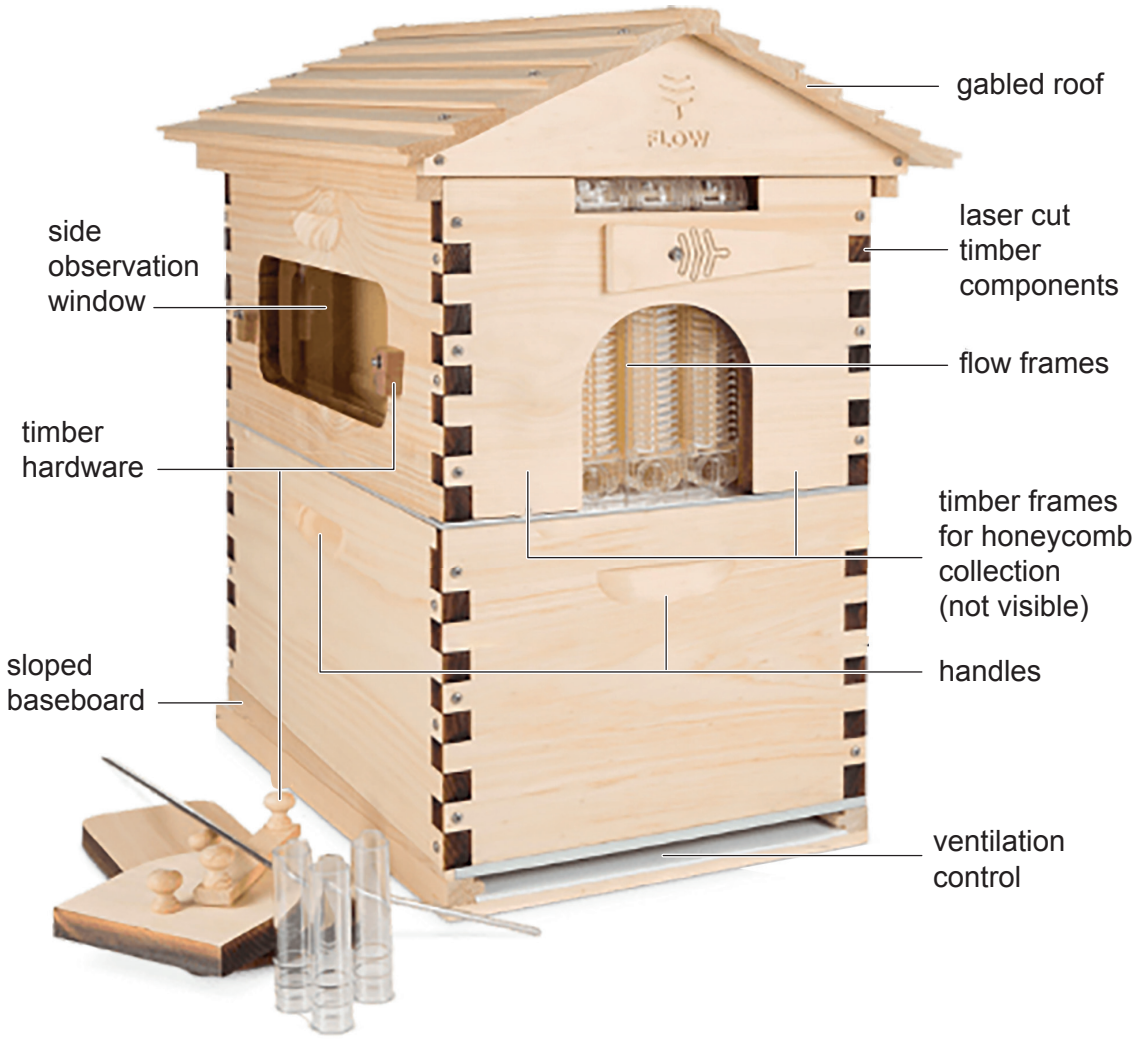
- orthographic drawing
- prototypes
- computer-aided design (CAD) modelling [9]

6. Beekeeping has become a popular activity associated with conservation and promoting emotional wellbeing. Flow Hive© (**Figure 12** and **Figure 13**) is a simple to use product, that has been designed for beekeeping beginners to understand how to harvest honey.

Designed by a father and son team in 2015, Flow Hive© grew rapidly from its "start-up" origins as a company seeking crowdsource funding to a thriving business offering a variety of products and accessories as part of their developing range (**Figure 14**).

Flow Hive© is sold as a self-assembly kit with simple instructions making the setup and use of the hive easy and intuitive. The hive is made from treated softwood timber sourced from sustainably managed forests. Flow Hives© are manufactured using computer numerical control (CNC) and laser cut components, allowing for large scale production.

Figure 12: The Flow Hive© box



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(Question 6 continued)

Figure 13: Honey produced in the internal frames

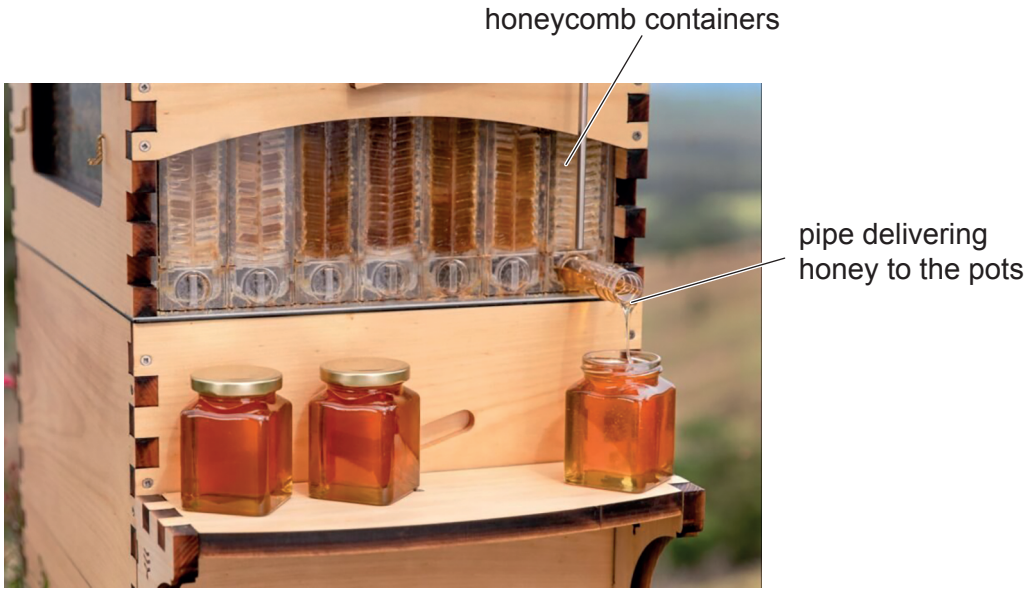

Figure 14: A range of different Flow Hive© versions

Flow Hive 2+
From $1,179

Flow Hive 2
From $979

Flow Hive Classic
From $879

Flow Hive Hybrid
From $679

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(Question 6 continued)

(a) Outline **two** reasons why it is important to apply treatment and finishing solutions to timber products for outdoor use. [2]

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(b) Explain how the concept of **"**renewability" has been considered in the decision to use timbers from sustainably managed forests. [3]

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(Question 6 continued)

(c) Explain how "practical function" **and** "psychological function" influence the design of the Flow Hive©. [6]

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will not be marked.

(Question 6 continued)

(d) Explain how development of the Flow Hive© idea could be considered as "process innovation", "sustaining innovation" **and** lead the company to developing different product versions. [9]

7. LOTA+™ (Locally Optimized Toilet for All), see **Figure 15**, is a company that aims to improve access to affordable and sustainable sanitation solutions by creating innovative toilets based on the principles of a circular economy and resource recovery.

The name "*Lota*" is based on a Hindi word for "a small traditional water vessel" which is found in almost all homes in India as an everyday item associated with hygiene and cleanliness (**Figure 16**).

The toilet is intended to be self-assembled using standard modular components parts (**Figure 17**). Using a participatory design approach, the toilet is constructed and installed by the family who are provided with the basic tools and materials needed to build the toilet themselves.

LOTA+™ uses locally sourced, reclaimed materials such as salvaged plywood or stone sheeting including granite, mica or sandstone recovered from the building industry for constructing their "off-grid" toilets (**Figure 18**).

Figure 15: LOTA+™ (Locally Optimized Toilet for All)

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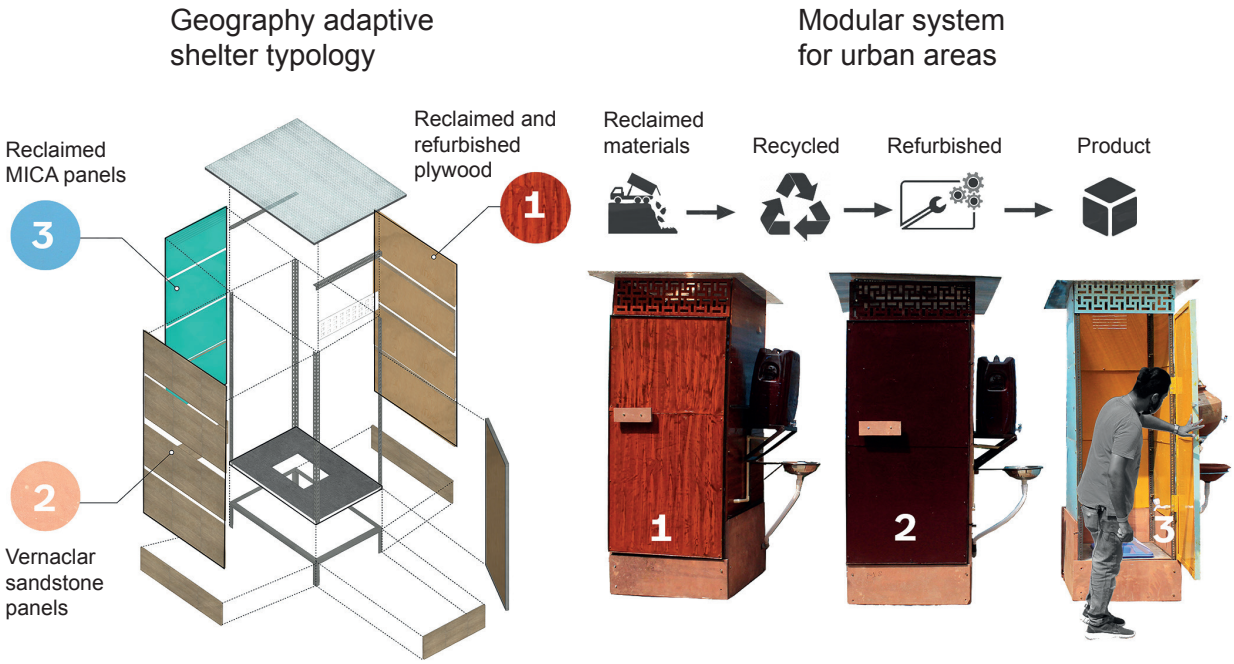
(Question 7 continued)

Figure 16: A traditional "Lota" or water vessel

Figure 17: The modular system used to construct the LOTA+™



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(Question 7 continued)

Figure 18: Prototype development

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(Question 7 continued)

(a) Describe why the traditional Lota water vessel is both ubiquitous and omnipresent in Indian culture (**Figure 16**). [2]

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(b) Explain the benefits of using conceptual modelling as shown in **Figure 18**. [3]

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(Question 7 continued)

(c) Explain how LOTA+™ has encouraged the following:

- material recovery

and

- the concept of a circular economy in their design. [6]

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(Question 7 continued)

(d) Explain how the designers have considered the following principles in the development of the LOTA+™:

- design for materials,
- design for assembly,
- design for manufacture [9]

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References:

Figure 1: With permission from Petit Pli.

Figure 2: Creation of icons and illustrations, 2023. *The baby is crawling black line icon. Toddler development. – stock illustration*. [image online] Available at: https://www.gettyimages.co.uk/detail/illustration/the-baby-is-crawling-black-line-icon-toddler-royalty-free-illustration/1763270523 [Accessed 5 November 2024]. Source adapted.

Kimura, 2024. *Full body set of family [Vector / illustration / person] – stock illustration*. [image online] Available at: https://www.gettyimages.co.uk/detail/illustration/full-body-set-of-royalty-free-illustration/2165054067 [Accessed 5 November 2024]. Source adapted.

Figure 3: [Left image]: With permission from Petit Pli.

[Right image]: With permission from Oxford Space Systems.

Figure 4: With permission from Petit Pli.

Figure 5a: With permission from Hiroyuki Morita.

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Figure 13: With permission from Flow.

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Figure 15: LOTA+. 2021 Available at: https://www.jamesdysonaward.org/en-US/2021/project/lota-locally-optimized-toilet-for-all/ [Accessed 5 November 2024].

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Figure 17: LOTA+. 2021 Available at: https://www.jamesdysonaward.org/en-US/2021/project/lota-locally-optimized-toilet-for-all/ [Accessed 5 November 2024].

Figure 18: LOTA+. 2021 Available at: https://www.jamesdysonaward.org/en-US/2021/project/lota-locally-optimized-toilet-for-all/ [Accessed 5 November 2024].


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