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Write your **student number** in the boxes above.

Letter

Product Design and Technologies

Question and Answer Book

VCE Examination – Friday 8 November 2024

- Reading time is **15 minutes**: 9.00 am to 9.15 am
- Writing time is **1 hour 30 minutes**: 9.15 am to 10.45 am

Approved materials

- Coloured pencils, water-based pens and markers

Materials supplied

- Question and Answer Book of 20 pages

Students are **not** permitted to bring mobile phones and/or any unauthorised electronic devices into the examination room.

Contents	pages
17 questions (90 marks)	2–17

Instructions

- Answer **all** questions in the spaces provided.
- Write your responses in English.

Use the following information to answer Questions 1–9.

Mycelium-grown biobricks by Ecovative Design

Mycelium, the vegetative stage of mushrooms, has recently been used to create eco-friendly bricks. These bricks are made by mixing mycelium with agricultural waste, such as straw or sawdust. As the mycelium grows, it binds the materials together, forming a strong and durable brick. Each brick has a unique and organic appearance, and its shape can be customised.

These bricks are lighter than traditional clay bricks, which makes them easier to handle and transport. This also can result in reduced materials required for construction frames and a reduction in overall construction costs. They offer excellent thermal and acoustic insulation, helping to maintain comfortable indoor temperatures and reduce noise. These bricks resist moisture, are mould resistant and can be treated to enhance their resistance to fire.

When exposed to the right conditions, these bricks are biodegradable so they can break down naturally when no longer needed.

The mycelium used is harmless to humans and the environment.



Source: Photo Rododendrites; licensed CC-BY-SA 4.0 <<https://creativecommons.org/licenses/by-sa/4.0/deed.en>>

Question 1 (4 marks)

- a. Formulate **one** profile of an end user for the mycelium-grown bricks by Ecovative Design. 2 marks

- b. Identify two constraints this end user could have required for this product. 2 marks

Constraint 1 _____

Constraint 2 _____

Question 2 (4 marks)

Designers of the mycelium-grown bricks would have developed evaluation criteria to use throughout the design process.

Using the constraints you identified in **Question 1b**, evaluate the Ecovative Design bricks.

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Question 3 (7 marks)

a. Discuss **two** features of the circular economy.

4 marks

b. Analyse how the Ecovative Design bricks utilise the circular economy.

3 marks

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Question 4 (4 marks)

In the first diamond of the Double Diamond design approach, designers work through the ‘investigating and defining’ activities.

Identify and describe one creative thinking technique and one critical thinking technique during these activities that is relevant to the development of the Ecovative Design bricks.

Creative thinking technique _____

Critical thinking technique _____

Question 5 (4 marks)

Describe **one** example of primary research and **one** example of secondary research that Ecovative Design may have conducted when designing the mycelium-grown bricks.

Primary

Secondary

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Question 7 (4 marks)

Consumers can grow mycelium to make products in their own homes or local communities.

Discuss one positive and one negative impact this process may have on consumers.

Positive

Negative

Question 8 (3 marks)

It is speculated that future products made from mycelium-based materials, including clothing and footwear, will offer end users sustainable and biodegradable alternatives to synthetic materials.

Discuss how an information campaign about the sourcing, production and life cycle of mycelium-based products may encourage entrepreneurial activities within the design industry.

Question 9 (3 marks)

Ethical products can promote respect and concern for humans and non-humans.

Explain **one** reason why mycelium-based products may be considered ethical.

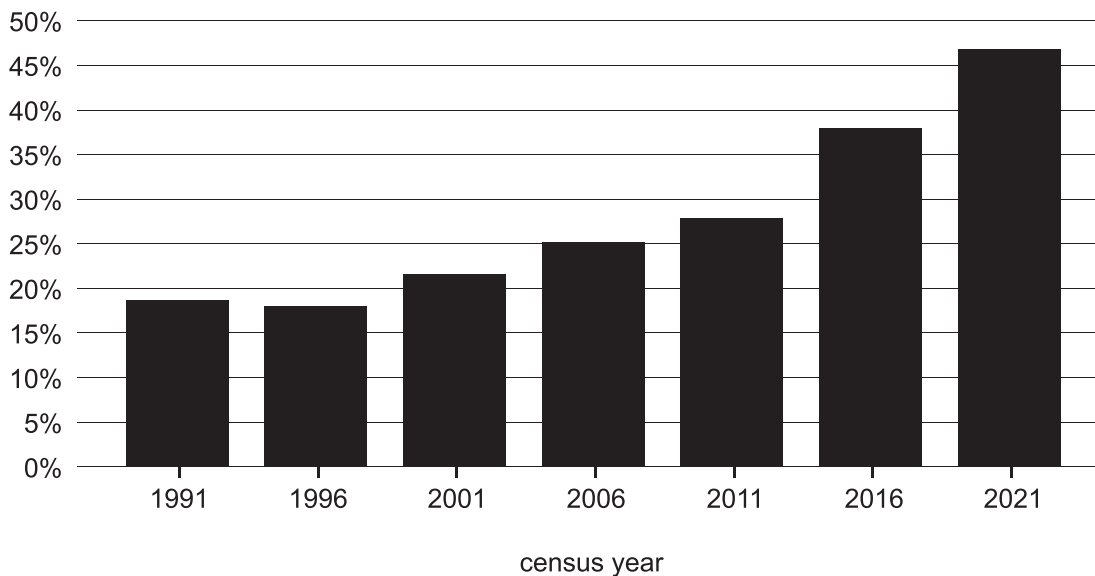
Use the following information to answer Questions 10–12.

Higher density living

In Australia, more people are choosing to live in apartments, which are generally cheaper to buy than houses. These apartments are significantly smaller than typical houses.

Over the past 30 years, the number of occupied apartments across the country has more than doubled – up 108% – to 1 418 898 dwellings at the 2021 Census.

Percentage of apartments in a more-than-four-storey block, 1991–2021



Source: Adapted from E Creagh, 'More Aussies than ever live in units, and not even COVID slowed down the trend', 4 July 2022 <realestate.com.au>

Question 10 (4 marks)

- a. Using the information provided above, describe **one** method of investigating market needs or opportunities. 2 marks

- b. Outline **two** ethical considerations when gathering research. 2 marks

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Question 11 (22 marks)

- a. The shift towards smaller housing sizes creates an increasing need for products tailored to smaller living spaces.

Designers need to address concerns of end users and design products that are:

- compact/space-saving
- multi-functional.

In the table below:

- describe two multi-functional and space-saving product concepts for apartment living
- identify two different functions for each product concept.

6 marks

	Description	Function 1	Function 2
Product concept 1			
Product concept 2			

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Question 11 continues on the next page.

- b.** From **one** of the product concepts identified in **part a**, draw and annotate two different visualisations that address the concerns of apartment living.

Your response to this question will be assessed against the following assessment criteria:

Clarity of visualisations	4 marks
Annotations that relate to end user concerns	4 marks
Demonstration of creative thinking	4 marks

1.

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2.

- c. Focusing on **one** of the visualisations in **part b**, critique how it may meet end users' needs.

4 marks

Visualisation number: _____

Multi-functional

Compact/space saving

Question 12 (3 marks)

One of the visualisations from **Question 11b** has been chosen as a final proof of concept and will go into production. The manufacturer will need to manage time and resources to be efficient and effective.

Identify and describe **one** method used to manage time and/or resources to ensure that a quality product is produced efficiently and effectively.

Question 13 (5 marks)

a. Identify **one** property of a material that might be important to consider when designing a product. 1 mark

b. Describe **one** experiment, test or trial that could be used to test this property. 2 marks

c. Explain how the findings of this experiment, test or trial may help to justify a chosen product concept. 2 marks

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Use the following information to answer Questions 14–17.

HEXR is a new standard in helmet safety and performance. Every helmet is custom-made to fit your head. Using a smartphone app, customers are supported through a self-fitting process by an augmented-reality guidance system. A helmet fitting can be conducted anywhere in the world to scan the measurements needed to make the custom helmet.

HEXR utilises additive manufacturing rapid 3D prototyping to create a unique honeycomb structure. It takes 36 hours to print a batch of six helmets.

HEXR manufactures the helmets from a plant-based material called Polyamide-11, which is made from 100% castor bean oil. The sourcing of this material supports sustainable farming practices, reduced water use and fair treatment of workers. Castor beans are a viable alternative to petroleum: 100% renewable and grown in a year, the beans are drought-resistant and thrive where other crops struggle to grow.

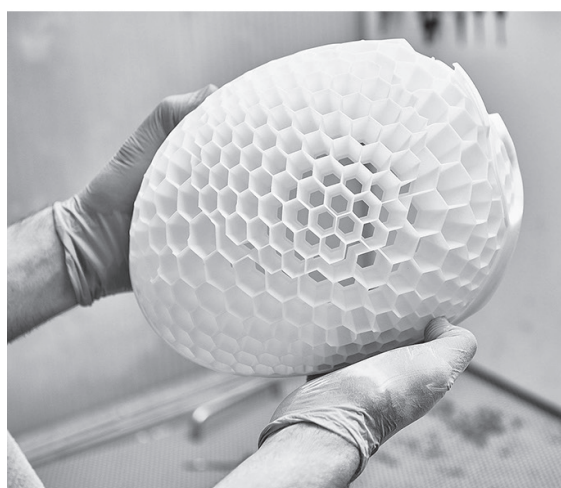
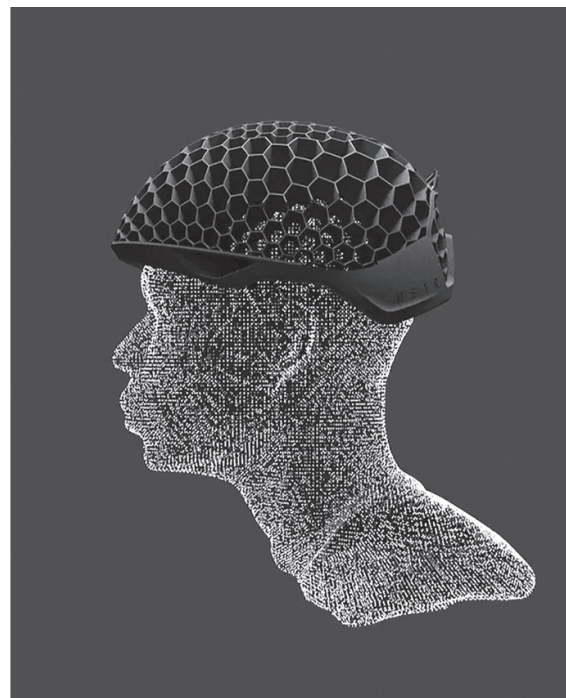
HEXR uses sustainable packaging, and no stock sits on a shelf gathering dust.

HEXR’s extensive safety testing has found the helmet’s honeycomb structures have the highest crush-strength to weight ratio, meaning they are excellent at shock absorption.

BREAKTHROUGH SAFETY

Extensive testing proves the highest safety on the market. Our tests prove that HEXR helmets are better than any of our competitors’ current foam helmets.

+26% safer



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Question 14 (3 marks)

The polymer and unique honeycomb structure used in the HEXR helmet is stronger than current foam helmets.

Discuss **one** way that research and development (R&D) in relation to Polyamide-11 could contribute to innovation.

Question 15 (4 marks)

The HEXR helmet has gone through multiple prototyping stages to develop a final proof of concept.

- a. Describe the purpose of prototyping. 2 marks

- b. Describe how prototyping is used to justify a chosen product concept. 2 marks

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Question 16 (6 marks)

Use of the HEXR smartphone app to custom-fit helmets could be considered an example of artificial intelligence (AI) technology.

Critique the impact of the smartphone app for both consumers and producers.

Consumers

Producers

Question 17 (2 marks)

Lean manufacturing and flexible and responsive manufacturing are both strategies aimed at improving production, efficiency and effectiveness, but they differ in focus and implementation.

Describe how the manufacturing process of the HEXR helmet could be considered an example of flexible and responsive manufacturing.

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