

Design technology

Higher level and standard level

Paper 2

Thursday 11 May 2017 (afternoon)

Candidate session number

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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.
- Write your answers in the boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is **[50 marks]**.



Section A

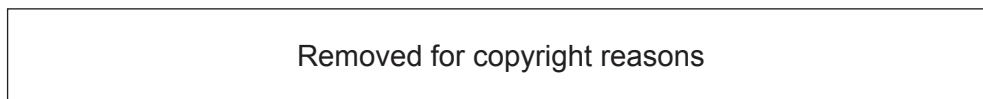
Answer **all** questions. Answers must be written within the answer boxes provided.

1. Many homeowners are aware that they are using large quantities of electricity. This is not only costly, but is also harmful to the environment as much of it is obtained from non-renewable sources.

Figure 1 shows Powerwall, a home battery developed by Tesla, an international company with its Head Office in the United States. The Powerwall charges using electricity generated from solar panels, and powers the home in the evening. It also protects the home against power outages by providing a backup electricity supply.

The Powerwall can be easily installed either indoors or outdoors by a professional electrician. Tesla are well known for their development of batteries for motor cars (automobiles). This is known as adaptation.

Figure 1: Tesla Powerwall



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28EP02

(Question 1 continued)

Figure 2: Powerwall data

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(a) (i) State **one** reason why the Tesla Powerwall needs to be easily accessible. [1]

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(ii) Outline how the Powerwall can be seen as an example of eco-design. [2]

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28EP03

Turn over

(Question 1 continued)

- (b) (i) Outline the difference between a renewable and non-renewable source of energy. [2]

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- (ii) Poor battery management/storage reduces battery life. Outline why the efficiency of the lithium ion battery will not remain at 92%. [2]

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- (c) (i) A consumer who already has solar panels on their roof is considering whether to purchase the Powerwall. The solar panels generate 2,760 kWh per year. The cost of the solar panels was US\$4,000.

Calculate the time it would take for the Powerwall to pay for itself using energy generated from the solar panels. [2]

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(Question 1 continued)

(ii) Explain the influence of technology push and market pull in the development of the Powerwall.

[3]

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28EP05

Turn over

(Question 1 continued)

Figure 3 shows a safety pin made of steel wire. The safety pin was invented by Walter Hunt while wondering how to pay back a fifteen-dollar debt to a friend. In 1849, Hunt patented his invention and sold it to a manufacturing company for mass production. Steel wire is manufactured from pig iron in a number of steps of treatment in order to achieve the desired properties.

Safety pins may be made from steels with different percentages of carbon depending on the intended user. Hospitals would require safety pins with relatively high carbon content, whereas those purchased from stationery shops have a relatively low carbon content.

Figure 3: Safety pin



[Source: https://commons.wikimedia.org/wiki/File:Safety_Pin.jpg, Haragayato — Wikimedia Commons]

- (d) (i) State the strategy of innovation for the safety pin. [1]

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- (ii) Outline why there is no longer a patent for the safety pin. [2]

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28EP06

(Question 1 continued)

- (e) (i) Outline how grain size of the steel material affects the properties of the safety pin. [2]

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- (ii) Explain the benefits of using hardening and tempering techniques in the manufacture of the safety pin. [3]

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2. **Figure 4** shows a glass pool table. The playing area is made of a toughened glass. However, pool cannot be played on a glass surface as there is not enough friction to make the game realistic.

To make the surface more realistic the toughened glass is covered by a thin transparent surface, known as Vitrik, which replicates the cloth of a traditional pool table (**Figure 5**).

Figure 4: Glass pool table



[Source: www.eliteinnovations.com.au]

Figure 5: A traditional pool table



[Source: Photo by DodgertonSkillhouse at Morguefile.com]

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28EP08

(Question 2 continued)

(a) (i) Outline why the glass pool table is made from toughened glass.

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(ii) Outline why the pool table may be made from glass rather than the traditional materials of slate covered by a green material shown in **Figure 5**.

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28EP09

Turn over

3. **Figure 6** shows an Xbox 360 controller that has a curved shape case made of a thermoplastic material.

The Xbox 360 Controller has four action buttons, coloured and labelled as X, Y, A and B as well as two rubber thumb sticks that are buttons covered with a rubber-like material.

The design team would have used various types of models in the development of the Xbox 360 Controller.

Figure 6: Xbox 360 controller



[Source: <https://commons.wikimedia.org/wiki/File:Xbox-360-Wireless-Controller-White.jpg>]

Explain why the design team would have used physical modelling to test the ergonomic characteristics of the Xbox 360 controller.

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28EP10

4. Explain **one** advantage of a cradle to cradle philosophy over a cradle to grave philosophy. [3]

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Section B

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

5. It is claimed that the design for the Ray-Ban™ Aviator sunglasses was based on the story of American pilot John Macready who after seeing the damage caused to a fellow pilot's eyes who was wearing goggles (**Figure 7**) contacted Bausch & Lomb, a company that specialised in photographic lenses. The hand sketched designs given to Bausch & Lomb were used as the design brief for the Aviator sunglasses (**Figure 8**).

Since the first sales of the Ray-Ban™ Aviator sunglasses in 1937 their enduring appeal has led them to be considered as a design classic. This position in the public consciousness has been helped by General MacArthur, the US Commander of US Forces in East Asia in World War 2, being seen wearing them in 1945 and being worn in Hollywood films such as Top Gun starring Tom Cruise, released in 1986.

The Ray-Ban™ Aviator sunglasses are sold with three sizes of lens; 55 mm, 58 mm and 62 mm. The size of the lens dictates the size of the frames.

Figure 7: Aviator Goggles



[Source: Photo credit: SFO Museum, San Francisco International Airport.
Object courtesy of Pima Air & Space Museum, Tucson, Arizona.]

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28EP12

(Question 5 continued)

Figure 8: Ray-Ban™ Aviator sunglasses



[Source: <https://commons.wikimedia.org/wiki/File:RayBanAviator.jpg>]

(a) Outline why the Ray-Ban™ Aviator sunglasses are only sold in three sizes.

[2]

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28EP13

Turn over

(Question 5 continued)

- (b) Explain why the Ray-Ban™ Aviator sunglasses may be seen as an example of adaptation.

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28EP14

(Question 5 continued)

- (c) Explain the relevance of the balance between form and function in the design of the Ray-Ban™ Aviator sunglasses in **Figure 8**.

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28EP15

Turn over

6. **Figure 9** shows the Juicy Salif Citrus Squeezer designed by Philippe Starck and made from casting aluminum which is then polished.

Figure 9: Philippe Starck's Citrus Squeezer

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28EP17

Turn over

(Question 6 continued)

Figure 10

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- (a) Outline **one** reason why the concept development of the Juicy Salif Citrus Squeezer may be considered as an act of insight.

[2]

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28EP18

(Question 6 continued)

- (b) Explain why Rogers' characteristic of observability would be most important in the commercial success of the product.

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28EP19

Turn over

(Question 6 continued)

- (c) Discuss the design of the Juicy Salif Citrus Squeezer in relation to practical function and psychological factors.

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28EP20

(Question 6 continued)

(d) Explain **three** reasons why casting would be used to produce the Juicy Salif Citrus Squeezer in **Figure 9**.

[9]

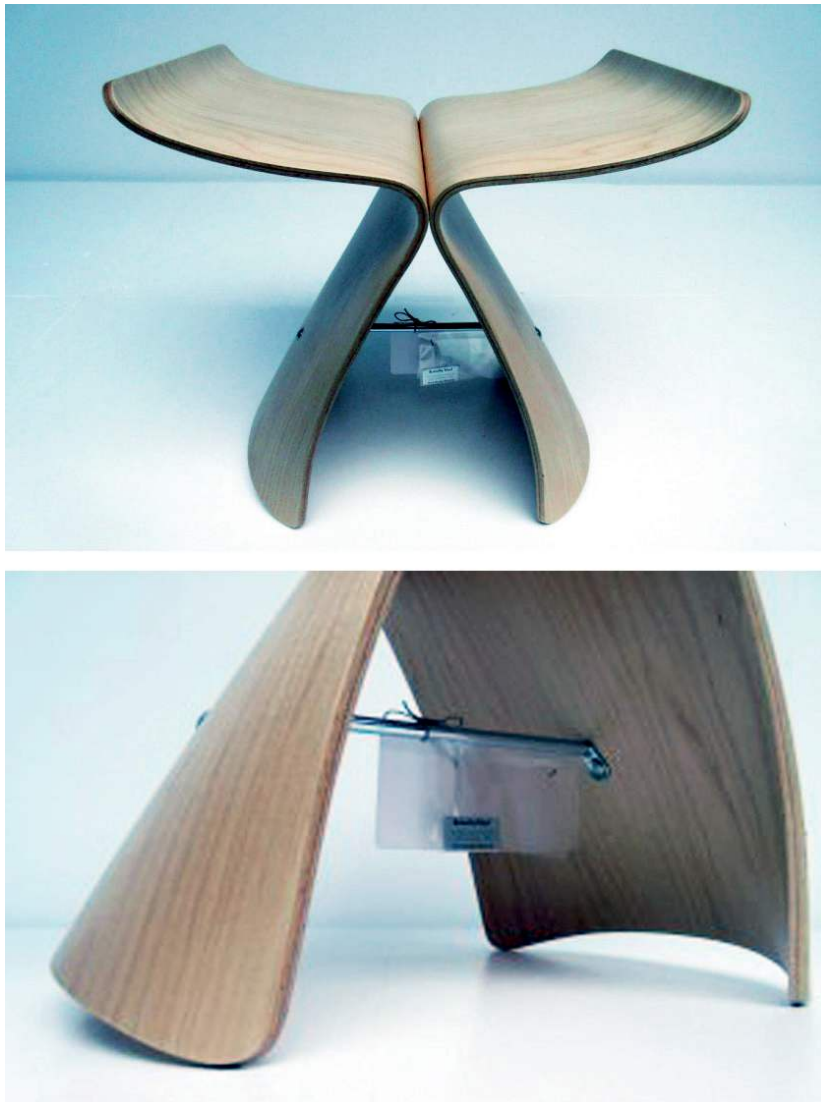
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Turn over

7. **Figure 11** shows a Butterfly Stool made of two identical pieces of plywood, joined in the centre with a single metal rod and connected under the seat by just two screws.

Figure 11: Butterfly Stool



[Source: <http://hellodesign.nl>]

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28EP22

(Question 7 continued)

- (a) List **two** ways that the principle of Design for disassembly influences the design development of the Butterfly Stool.

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- (b) Explain how the concept of stress is relevant to the design development of the metallic bar connecting the two pieces of plywood in **Figure 11**.

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28EP23

Turn over

(Question 7 continued)

(c) Discuss the design of the Butterfly Stool in relation to anthropometric and physiological factors.

[6]

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28EP24

(Question 7 continued)

(d) Explain **three** characteristics of plywood that are important in the design of the Butterfly Stool.

[9]

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28EP25

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28EP26

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28EP27

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28EP28