Diploma Programme
Programme du diplôme
Programa del Diploma

Design technology
Higher level and standard level
Paper 2

Thursday 11 May 2017 (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.
- Write your answers in the boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is **[50 marks]**.

2217 – 6203

25 pages

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

Removed for copyright reasons

(This question continues on the following page)

(Question 1 continued)

Figure 2: Powerwall data

Removed for copyright reasons

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

. . . . . .
. . . . . .

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

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

(This question continues on the following page)

(Question 1 continued)

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

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

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

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

(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]

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

(This question continues on the following page)

(Question 1 continued)

(ii) Explain the influence of technology push and market pull in the development of the Powerwall. [3]

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

(This question continues on the following page)

(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]

. . . . . .
. . . . . .

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

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

(This question continues on the following page)

(Question 1 continued)

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

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

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

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

2. **Figure 4 s**hows 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 DodgertonSkillhause at Morguefile.com]

(This question continues on the following page)

(Question 2 continued)

(a) (i) Outline why the glass pool table is made from toughened glass. [2]

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

(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**. [2]

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

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. [3]

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

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

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

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.]

(This question continues on the following page)

(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]

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(This question continues on the following page)

(Question 5 continued)

(b) Explain why the Ray-Ban™ Aviator sunglasses may be seen as an example of adaptation. [3]

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

(This question continues on the following page)

(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**. [6]

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

(This question continues on the following page)

(Question 5 continued)

(d) Explain **three** reasons why the Ray-Ban Aviator™ sunglasses may be considered as a classic design. [9]

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

(This question continues on the following page)

(Question 6 continued)

Figure 10

Removed for copyright reasons

(a) Outline **one** reason why the concept development of the Juicy Salif Citrus Squeezer may be considered as an act of insight. [2]

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(This question continues on the following page)

(Question 6 continued)

(b) Explain why Rogers' characteristic of observability would be most important in the commercial success of the product. [3]

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

(This question continues on the following page)

(Question 6 continued)

(c) Discuss the design of the Juicy Salif Citrus Squeezer in relation to practical function and psychological factors. [6]

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

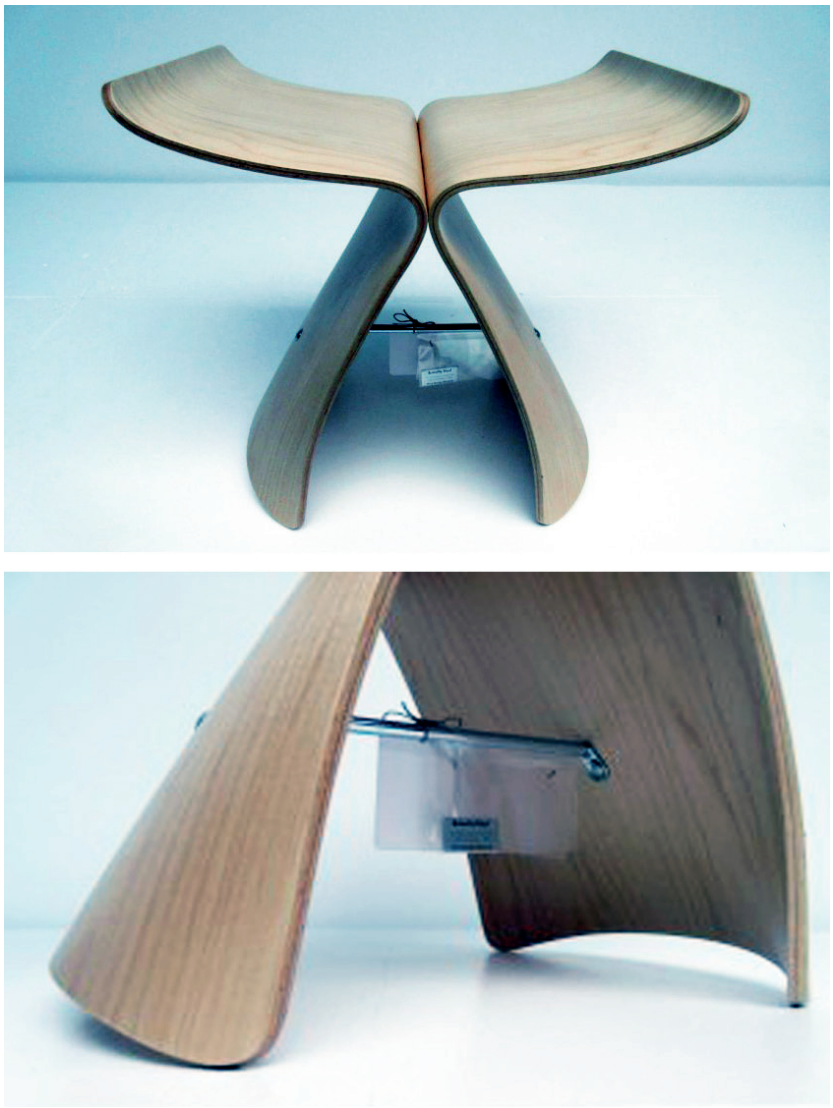
(This question continues on the following page)

(Question 6 continued)

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

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]

(This question continues on the following page)

(Question 7 continued)

(a) List **two** ways that the principle of Design for disassembly influences the design development of the Butterfly Stool. [2]

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(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**. [3]

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

(This question continues on the following page)

(Question 7 continued)

(c) Discuss the design of the Butterfly Stool in relation to anthropometric and physiological factors. [6]

. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .
. . . . . .

(This question continues on the following page)

(Question 7 continued)

(d) Explain **three** characteristics of plywood that are important in the design of the Butterfly Stool. [9]

Please **do not** write on this page.

Answers written on this page
will not be marked.

Please **do not** write on this page.

Answers written on this page
will not be marked.

Please **do not** write on this page.

Answers written on this page
will not be marked.