Diploma Programme
Programme du diplôme
Programa del Diploma

Design technology
Higher level and standard level
Paper 2

Thursday 12 May 2016 (morning)

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]**.

2216 – 6203

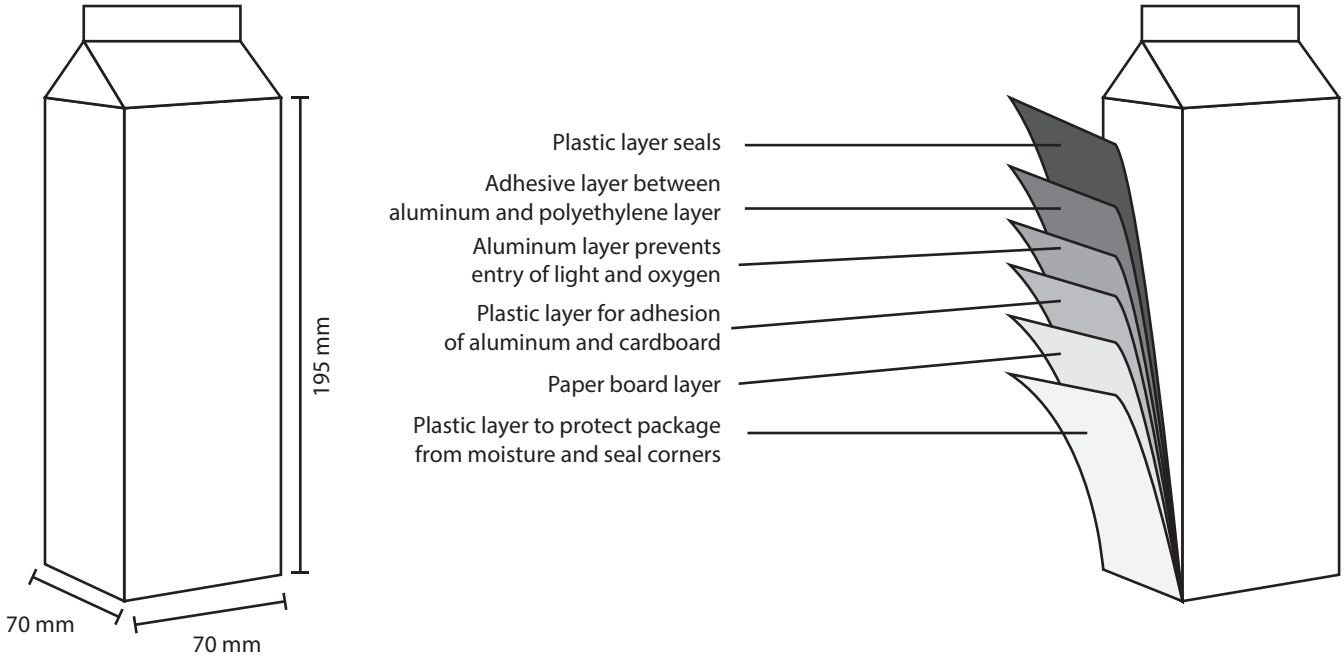
23 pages

Section A

Answer **all** questions. Write your answers in the boxes provided.

1. **Figure 1** shows a sketch of a typical Tetra Pak carton. Tetra Pak cartons were developed in Sweden in 1951 to replace the glass containers commonly used at the time.

Figure 1: A sketch of a typical Tetra Pak carton



[Source: © International Baccalaureate Organization 2016]

(a) (i) State **one** piece of anthropometric data important to the design of the carton in **Figure 1**. [1]

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(This question continues on the following page)

(Question 1 continued)

(ii) Outline **one** reason for the design of the flap at the top of the Tetra Pak carton. [2]

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(b) (i) Outline **one** advantage of the multiple layer construction of the Tetra Pak carton. [2]

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(ii) Outline why the Tetra Pak company uses a trademark symbol (™) on its cartons. [2]

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(Question 1 continued)

(c) (i) Outline **one** method that the Tetra Pak company could use to increase the recyclability of its cartons. [2]

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(ii) Explain **one** advantage of the Tetra Pak cartons compared to the glass containers that they replaced. [3]

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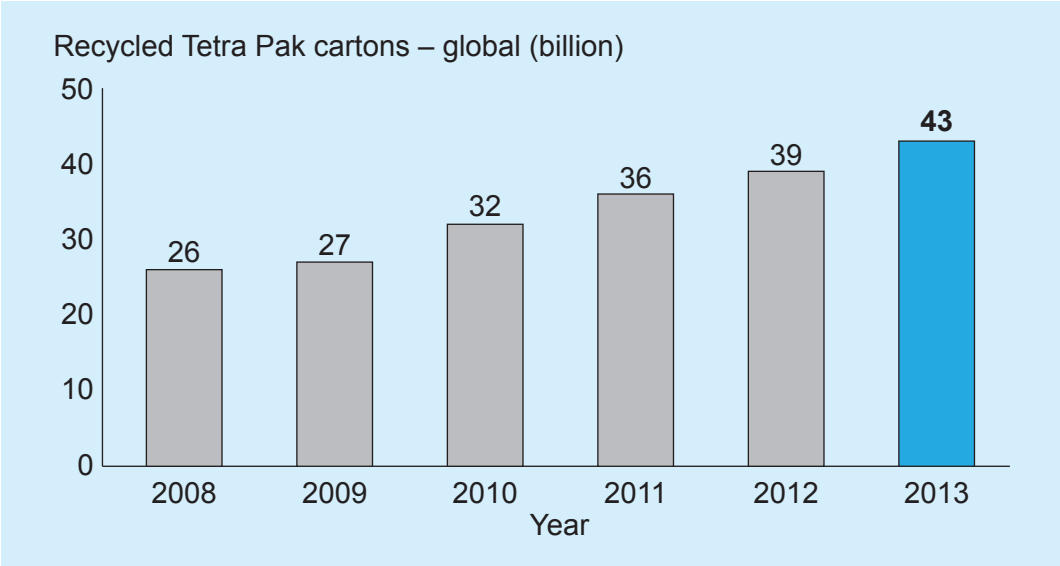
(Question 1 continued)

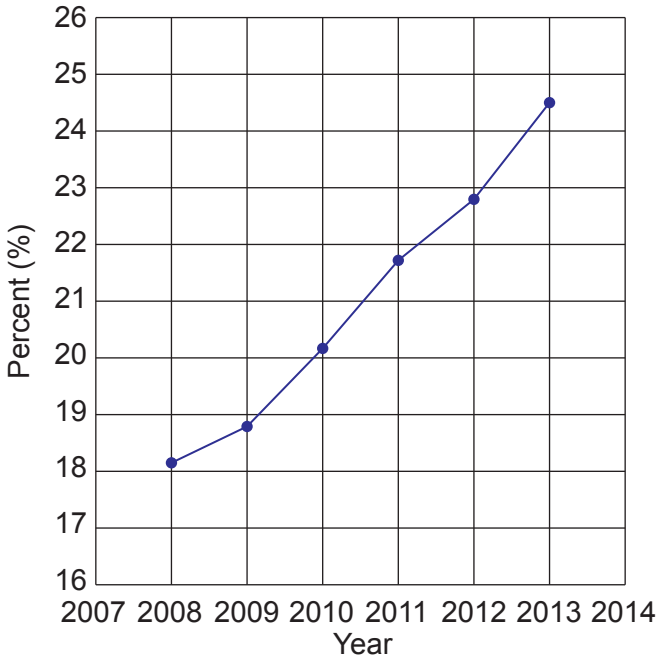
Figure 2a shows the quantity (billions) and **Figure 2b** the recycling rate (percent) of used Tetra Pak cartons since 2008. Tetra Pak management wishes to increase the recycling rate to 40 % by 2020, double the rate in 2010.

Figure 2a: The number, in billions, of used Tetra Pak cartons recycled over a six-year period



[Source: http://sustainability.tetrapak.com]

Figure 2b: The percentage of cartons recycled over the same six-year period



[Source: http://sustainability.tetrapak.com]

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(Question 1 continued)

(d) (i) Using the information provided in **Figures 2a** and **2b**, calculate how many Tetra Pak cartons would have been manufactured in 2013. You must show your workings. [2]

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(ii) Outline **one** disadvantage of the Tetra Pak cartons compared to the glass containers that they replaced. [2]

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(Question 1 continued)

(e) (i) Outline **one** implication of dematerialization for the design of the Tetra Pak carton. [2]

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(ii) Outline **one** effect on the environment of the production of cardboard cartons. [2]

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2. Many bottles and cartons are sealed with screw caps as in **Figure 3**. Designers pay a great deal of attention to the force needed, torque, to turn the screw cap.

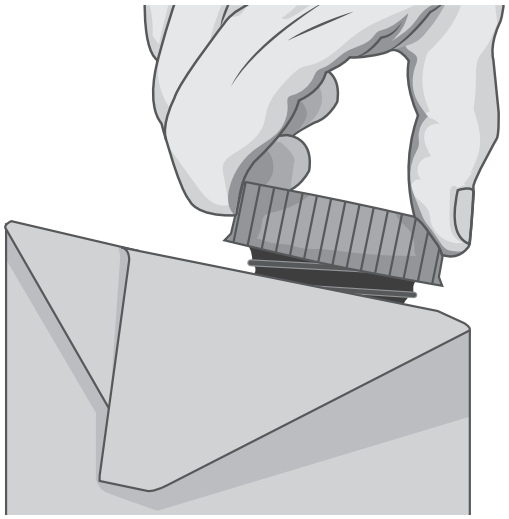
Torque is calculated as follows: $T = F \times d$

Where:

T – torque or turn necessary to open the screw cap, in Newton-metres (Nm)
F – handgrip force necessary to create friction to create torque, in Newtons (N)
d – diameter of the screw cap, in metres (m), see **Figure 4**.

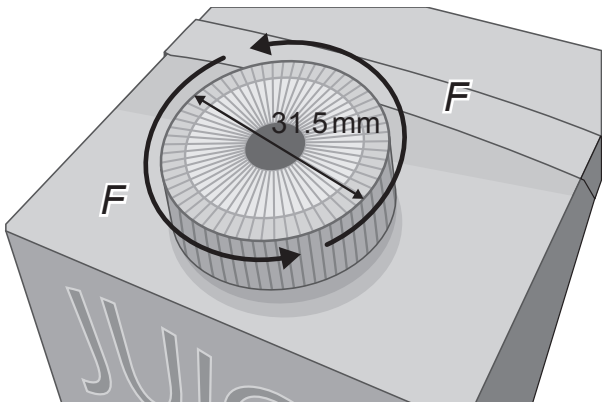
Package designers assume that users with no physical disability can produce a torque of 6.3 Nm.

Figure 3: Opening a screw cap carton



[Source: © International Baccalaureate Organization 2016]

Figure 4: Dimensions of the screw cap and indication of the direction of force applied



[Source: © International Baccalaureate Organization 2016]

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(Question 2 continued)

(a) Calculate the handgrip force applied as shown in **Figure 4**, to the screw cap if the required torque to open it is 6.3 Nm. [2]

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(b) Outline **one** physiological factor related to the design of the screw cap. [2]

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3. Explain why a small company may not adopt life cycle analysis as a strategy for reducing the environmental impacts of its products. [3]

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4. Discuss the implications of biodegradability in the development of new plastic materials. [3]

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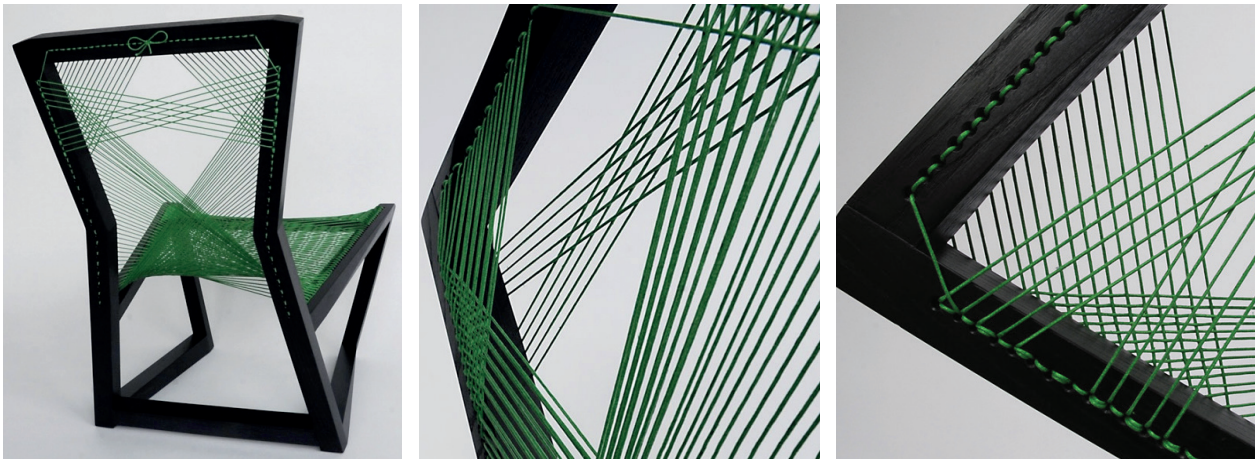
Section B

Answer **one** question. Write your answers in the boxes provided.

5. **Figure 5** shows the Woven Easy chair by Alexander Mueller. The chair has a hardwood frame (ash) which is stained to darken the wood. The seat and back of the chair are made from a single waxed cord. Cord is a textile material made from fibres.

Figure 5: Woven Easy chair by Alexander Mueller



[Source: Alexander Mueller, www.alexandermueller.co.uk/wove-easy-collection.html]

(a) Outline **one** reason why the textile cord is treated with wax. [2]

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(Question 5 continued)

(b) Explain why it is necessary for the textile fibres to be formed into a yarn to create the cord for the Woven Easy chair. [3]

(c) Discuss the design of the Woven Easy chair in relation to the balance between form **and** function. [6]

(This question continues on the following page)

(Question 5 continued)

(d) The manufacturers of the Woven Easy chair are considering an incremental change to the design that uses multiple cords instead of a single cord for the seat and the back of the chair.

Explain the implications of making this change with respect to production costs, ease of maintenance **and** durability. [9]

6. **Figure 6** shows the PlayShapes product by Miller Goodman. PlayShapes is a set of 74 modular hardwood shapes which are finished with paint or varnish. They can be used by young children of various ages to create hundreds of three-dimensional designs.

Figure 6: PlayShapes product by Miller Goodman

[Sources: http://cdn2.ahalife.com]

(a) (i) State **one** advantage of using paint to finish the parts of the PlayShapes product. [1]

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(ii) State **one** disadvantage of using paint to finish the parts of the PlayShapes product. [1]

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(Question 6 continued)

(b) Explain **one** characteristic of hardwood timber which is important for the nature of the PlayShapes design. [3]

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(c) Explain **two** advantages of combining computer-aided design (CAD) modelling with physical modelling to get feedback during the design development of the PlayShapes product. [6]

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(Question 6 continued)

(d) Explain Rogers' characteristics of relative advantage, observability and complexity in relation to anticipated consumer adoption of the PlayShapes product. [9]

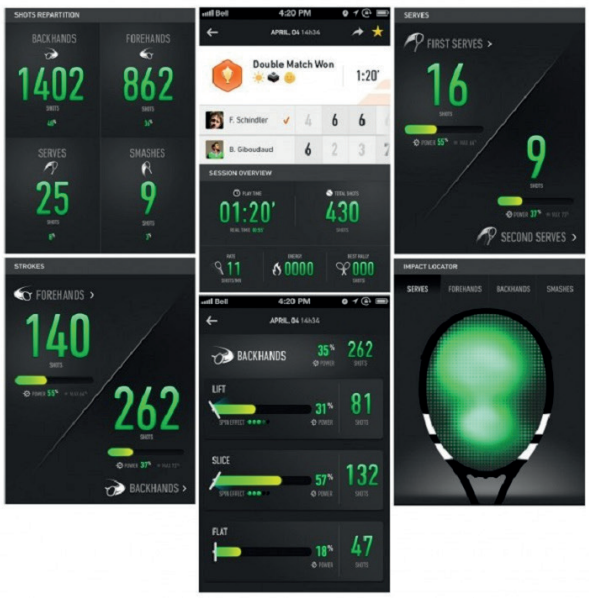
7. **Figure 7** shows the Babolat Play Pure Drive tennis racquet. The racquet handle contains sensors that collect data on the performance of the tennis player. This data is sent to a computer or smartphone that provides the user with feedback on their performance.

An example of this data is shown in **Figure 8**. In January 2014, after 10 years of development, the racquet was approved for use in competitions by the International Tennis Federation. The racquet has 2 buttons and a USB port inside the handle with a memory capacity of 150 hours of tennis-playing time and a battery life of six hours.

Figure 7: The Babolat Play Drive tennis racquet

[Sources: www.ubitennis.com and www.itftennis.com]

Figure 8: Data gathered from the Play Pure Drive tennis racquet



[Sources: www.eskimag.fr]

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(Question 7 continued)

(a) Outline the influence of technology push on the design of the Play Pure Drive tennis racquet. [2]

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(b) Explain why the product life of the Play Pure Drive tennis racquet is likely to be shorter than the product life of a conventional tennis racquet. [3]

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(Question 7 continued)

(c) Explain how the data collected by the Play Pure Drive tennis racquet contributes to a designer's understanding of biomechanics **and** the ongoing development of the tennis racquet. [6]

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(Question 7 continued)

(d) Explain how the use of percentile ranges, static data and dynamic data would contribute to the design of the Play Pure Drive tennis racquet. [9]

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