Diploma Programme
Programme du diplôme
Programa del Diploma

Design technology
Higher level
Paper 2

Thursday 14 May 2015 (afternoon)

Candidate session number

1 hour 45 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 **[60 marks]**.

2215 – 6202

23 pages

Section A

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

1. **Figure 1** shows the BBOXX plug and play solar system which links a solar panel to a battery pack into which people can plug accessories such as phone chargers, portable lights *etc*. The system was developed by three engineering students, Christopher Baker-Brian, Mansoor Hamayun and Laurent Van Houcke, while at university. With other students they founded a charity to develop and distribute solar-powered battery packs to locations with no national electricity grid available. After graduation the students formed a business selling the products to local companies in different countries. The local company purchases the system from BBOXX and obtains support from selling them and providing an after-sales service. Using local companies who know the market in their area rather than their own staff allowed a quick expansion for BBOXX into 14 countries by 2013. The systems are manufactured in China and typically cost £13 per month to run from the national grid compared to £10 per month for a petrol-based generator. **Table 1** shows data relating to the BBOXX battery and control unit. **Table 2** shows data relating to the solar panel.

Figure 1: BBOXX plug & play solar system

Table 1: Battery & control unit data

Battery:
- 12 V DC sealed head
- 84 Wh of stored energy
- Charged via the national grid or solar panel

Control Unit:
- Continuous 60 W DC output power
- Removable fuse
- Thermal overload and short circuit protection
- Battery state of change display
- 2 USB outputs
- 4 12 V DC outputs
- 95 % charging efficiency
- 20 °C – 25 °C recommended operation temperature range
- 184 mm × 80 mm × 260 mm dimensions
- 3.68 kg weight
- 60 cm drop test conducted
- 25 °C recommended storage temperature
- 18 months warranty (guarantee)

[Source: BBOXX Ltd. Used with permission]

(This question continues on the following page)

(Question 1 continued)

(a) (i) State **one** reason why consumers may purchase a BBOXX system rather than a petrol-powered system. [1]

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(ii) State the data from **Table 1** most likely to be affected by long-term use of the control unit. [1]

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(iii) Describe why the drop test for the control unit is from a 60 cm height. [2]

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(b) (i) Outline **one** advantage to the consumer of the 18 months warranty (guarantee). [2]

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(Question 1 continued)

(ii) Outline a design feature which takes into account the possible exposure of the control unit to high temperatures. [2]

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(c) (i) State **one** disadvantage of charging the battery from the national grid rather than from the solar panel. [1]

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(ii) Suggest **one** reason why the BBOXX system may be considered an appropriate technology. [3]

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(Question 1 continued)

Table 2: Data for the solar panel

• 15 W flexible polycrystalline panel
• 10 m of cable
• –40 °C to 85 °C operating temperature
• 60 m/s wind bearing
• Hail impact rate determined by 227 g steel ball dropped from 1 m height equivalent to a 25 mm hail stone at 97 km/h

[Source: BBOXX Ltd. Used with permission]

(d) (i) State the type of evaluation strategy that relates to the hail impact test. [1]

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(ii) Discuss **one** potential limitation of the hail impact test in relation to anticipated conditions of use for the solar panel. [3]

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(Question 1 continued)

(e) (i) Outline why it would be possible to use the solar panel in more global locations than the control unit. [2]

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(ii) Outline why the solar panel is designed to be flexible. [2]

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2. (a) State **one** reason why coal is a relatively cheap fuel source for many industrialized countries. [1]

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(b) Discuss whether clean coal technology eliminates the environmental impact of the use of coal as a major fuel source in industry. [3]

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3. (a) Describe how the structure of LVL timber makes it a suitable choice of material for roof beams spanning a roof 25 m long. [2]

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(b) Describe why LVL beams are often made to resemble beams made from solid natural timber. [2]

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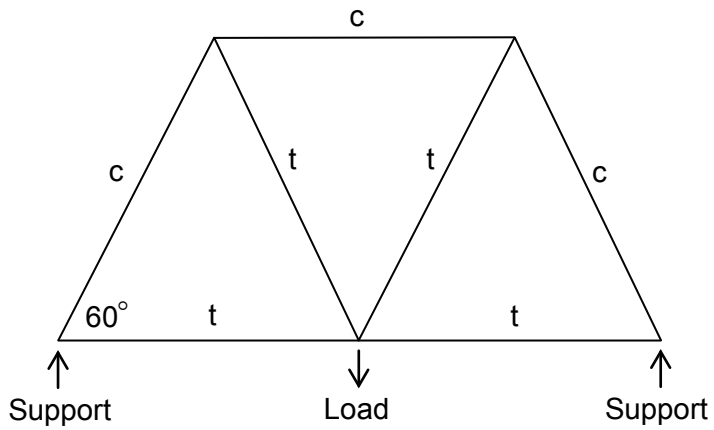
4. (a) **Figure 2** shows a 7-member structure with tensile (t) and compressive (c) forces identified.

Figure 2: 7-member structure



[Source: © International Baccalaureate Organization 2015]

State the type of load created by the mass of the structure in **Figure 2**. [1]

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(b) Explain why the structure in **Figure 2** is in equilibrium. [3]

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5. (a) **Figure 3** shows an electric belt sander machine used in workshops to abrade timber.

Figure 3: Electric belt sander

[Source: "Bandslijpmachine hobbykwaliteit (Westfalia)" by Pudding4brains – Own work. Licensed under Public Domain via Wikimedia Commons – https://commons.wikimedia.org/wiki/File:Bandslijpmachine_hobbykwaliteit_(Westfalia).jpg#/media/File:Bandslijpmachine_hobbykwaliteit_(Westfalia).jpg]

Outline **one** way in which it is easy for users to overload the machine shown in **Figure 3** when using it to abrade a piece of timber. [2]

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(b) Describe why belt sander machines may be considered low maintenance. [2]

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6. (a) State **one** key feature of a living building in relation to water usage. [1]

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(b) Discuss why the symbolic terms of “grey water” and “black water” are often used in relation to conservation of resources. [3]

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Section B

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

7. **Figure 4** shows a wooden (bamboo) wireless keyboard and mouse. The wooden bamboo timber is grown in tropical conditions from a sustainable resource. The keyboard and mouse both have a water and stain resistant gloss finish and are powered by two small batteries. **Figure 5** shows a close up of the keys on the keyboard.

Figure 4: Wooden keyboard and mouse

Figure 5: Keyboard close-up

[Source: www.safield.co.uk. Used with permission]

(a) (i) Describe the structure of timber as a natural composite material. [2]

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(ii) Describe how the design of the bamboo keyboard is seen as a combination of radical and incremental design. [2]

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(Question 7 continued)

(b) (i) Outline which category of Design for Manufacture (DfM) was a dominating constraint on the design brief for the keyboard and mouse. [2]

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(ii) Evaluate the bamboo keyboard in relation to ease of maintenance. [3]

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(c) (i) Outline what is meant by “the bamboo timber coming from a sustainable resource”. [2]

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(Question 7 continued)

(ii) Discuss **three** potential target markets for the bamboo keyboard and mouse. [9]

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8. **Figure 6** shows the S-shaped plastic red chair designed in 1967 by Vernon Panton and manufactured by Vitra. It is made from a single sheet of rigid polyurethane foam and copies of the original chair are now available in a selection of colours. In 1967 the chair was viewed as a radical design based on the use of new materials and manufacturing techniques.

Figure 6: Panton S-shaped chair

[Source: © Vitra. Used with permission]

(a) (i) Describe how plastic deformation contributes to the manufacture of the chair in **Figure 6**. [2]

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(ii) Describe how elastic deformation contributes to the performance of the chair in **Figure 6**. [2]

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(Question 8 continued)

(b) (i) Outline **one** reason why the chair in **Figure 6** was expensive to purchase in 1968 even though it is a simple structure made from a single sheet of plastic. [2]

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(ii) Discuss the surface finish of the chair in **Figure 6** in relation to comfort. [3]

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(c) (i) Outline the manufacturing technique for the chair in **Figure 6**. [2]

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(Question 8 continued)

(ii) Discuss **three** ways in which the designer of the chair in **Figure 6** has attempted to balance form with function. [9]

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9. **Figures 7a and 7b** show the Bladefish BF 3000 diving aid. It is designed for relatively inexperienced divers as the maximum depth of use is 30 m and the maximum speed is 4.25 km/h. The Bladefish can be used for 40 minutes before recharging which takes an hour to charge to 80 % capacity. The Bladefish has a 200 W power rating from an 18 V lithium ion battery. It measures 38 cm × 36 cm × 16 cm and weighs 4.4 kg. **Figure 8** shows the Bladefish packed in a standard suitcase.

Figures 7a and 7b: Bladefish diving aid

Figure 8 : Bladefish packed in luggage

[Source: www.bladefish.co.uk]

(This question continues on the following page)

(Question 9 continued)

(a) (i) Outline **one** potential limitation of the use of the Bladefish for observing underwater wildlife. [2]

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(ii) Outline **one** potential limitation of the Bladefish for use on holiday when travelling by air. [2]

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(b) (i) Outline **one** disadvantage of the Bladefish in relation to green design. [2]

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(Question 9 continued)

(ii) Discuss the design of the Bladefish in relation to maintenance. [3]

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(c) (i) Outline **one** limitation of the Bladefish when used by a family on holiday. [2]

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(Question 9 continued)

(ii) Discuss **three** potential safety issues for the use of the Bladefish. [9]

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