M10/4/DESTE/HP2/ENG/TZ0/XX

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International Baccalaureate
Baccalauréat International
Bachillerato Internacional

DESIGN TECHNOLOGY
HIGHER LEVEL
PAPER 2

Wednesday 12 May 2010 (afternoon)

1 hour 45 minutes

Candidate session number

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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 of Section A in the spaces provided.
- Section B: answer one question from Section B. Write your answers on answer sheets. Write your session number on each answer sheet, and attach them to this examination paper and your cover sheet using the tag provided.
- At the end of the examination, indicate the numbers of the questions answered in the candidate box on your cover sheet and indicate the number of sheets used in the appropriate box on your cover sheet.

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10 pages

SECTION A

*Answer **all** the questions in the spaces provided.*

1. **Figure 1** shows the first electric kettle to have a totally immersed heating element which was patented in 1921. Electric kettles have continuously evolved since their first introduction.

Kambrook, an Australian kettle manufacturer, undertook a Life Cycle Analysis (LCA) on one of their kettles (see **Table 1**) to form the basis for the design brief/ specification for a new kettle design.

Figure 1: First kettle with a totally immersed heating element

[Source: Copyright Science Museum/SSPL. Reproduced with permission]

Table 1: Life cycle analysis of a kettle to show the greenhouse gas emissions and solid waste resulting from energy consumption throughout the life cycle

Life cycle stage	Greenhouse gas emissions (kg)	Solid waste (g)
Manufacture of materials	18.6	428.1
Materials packaging and transport	0.2	0.0
Assembly and testing	0.1	1.5
Kettle packaging and transport	14.5	641.8
Operation and use of kettle	4703.5	244661.3
Disposal of kettle	0.0	1140.9

[Source: Reprinted with permission. The Centre for Sustainable Design www.cfsd.org.uk]

(a) (i) State the total greenhouse gas emissions for the life cycle stages. *[1]*

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(Question 1 continued)

(ii) State the total amount of solid waste from the life cycle assessment. *[1]*

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(iii) Calculate the percentage of solid waste produced at the operation and use stage of the life cycle compared to all the other stages. *[2]*

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(b) (i) Outline **one** reason why the amount of solid waste produced at the operation stage is so high. *[2]*

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(ii) State the main greenhouse gas emission produced in the operation and use stage of the life cycle. *[1]*

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(iii) Based on the data in Table 1 outline the most likely method of disposal for the kettle. *[2]*

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(Question 1 continued)

In 1996, Kambrook worked with the Royal Melbourne Institute of Technology to design a new kettle. The design team consisted of 16 specialists including designers, engineers, physicists, a social researcher, an environmental consultant and a polymer specialist. The new kettle is shown in **Figure 2** and:

- it used 25 % less electricity
- it had 40 % fewer components
- it used fewer types of material
- it was designed for disassembly
- it replaced glue and screws with snap fittings
- all components were labelled with internationally-recognised code marks.

Figure 2: The new Kambrook kettle

[Source: © Royal Melbourne Institute of Technology. Reprinted with permission. www.rmit.edu.au/cfd]

(c) (i) Suggest **one** reason for the need of a large design team for the kettle. *[3]*

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(ii) State which aspect of the redesign of the kettle will provide most environmental benefit. *[1]*

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(iii) Outline **one** benefit of designing the kettle for disassembly. *[2]*

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(Question 1 continued)

(d) (i) Suggest **one** reason for marking each component with internationally-recognised code marks. *[3]*

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(ii) Outline **one** advantage of reducing the variety of materials used for the new Kambrook kettle. *[2]*

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2. (a) State **one** type of pollution created by wind turbines in use. *[1]*

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(b) Compare the maintenance costs of on-shore and off-shore wind farms. *[3]*

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3. (a) Distinguish between potential energy and kinetic energy. *[2]*

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(b) Describe the type of energy used in stretching a rubber band. *[2]*

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4. (a) Define *building envelope*. *[1]*

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(b) Explain how the building envelope contributes to the amount of energy a building uses. *[3]*

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5. (a) Outline **one** reason why thermoplastics are suitable for vacuum forming. *[2]*

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(b) List **two** limitations of using vacuum forming to create packaging. *[2]*

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6. (a) State the unit used to measure torque. *[1]*

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(b) Explain the relationship between linear motion and rotational motion when riding a bicycle. *[3]*

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SECTION B

*Answer **one** question. Write your answers on the answer sheets provided. Write your session number on each answer sheet, and attach them to this examination paper and your cover sheet using the tag provided.*

7. **Figure 3** shows some candle lanterns made by hand using recycled metal from cans and glass. The design is based on the traditional arches and domes of classical Moorish architecture found in North Africa. Each lantern is unique in its decorative design depending on the surface design of the metal cans it is recycled from.

Figure 3: Lanterns made from recycled materials

[Source: www.burford.co.uk Reprinted with permission]

(a) (i) List **two** characteristics of glass apart from transparency which make it a suitable choice for the panels in the lanterns. *[2]*

(ii) Distinguish between one-off and batch production in the design and manufacture of the lanterns. *[2]*

(b) (i) Outline the most likely technique for joining the metal used in the manufacture of the lanterns. *[2]*

(ii) Explain how plastic deformation relates to the manufacture of the lanterns. *[3]*

(c) (i) Describe how the green design strategy *design for materials* has been used for the lanterns. *[2]*

(ii) Explain **three** ways in which the lanterns can be considered an example of appropriate technology. *[9]*

8. **Figure 4** shows a hammock manufactured by the company Sedi. It has a hardwood frame and a bed made from woven cotton (canvas). The hammock is self-assembly and the canvas bed is easily detachable from the frame.

Figure 4: The Sedi Hammock

[Source: www.sedifurniture.com]

(a) (i) Identify the type of forces acting on the hammock bed and the large beam caused by an external load of a person using the hammock. *[2]*

(ii) Explain the relevance of elastic strain to the performance of the hammock when used by a person. *[3]*

(b) (i) Outline **one** advantage to the consumer of the hammock being self-assembly. *[2]*

(ii) Describe how the technique of weaving impacts on the product life cycle of the hammock bed. *[2]*

(c) (i) Outline **one** reason for the choice of hardwood for the frame of the hammock. *[2]*

(ii) Explain **three** advantages of manufacturing the hammock frame with the technique of lamination. *[9]*

9. **Figure 5** shows an MP3 player designed to work under water to a depth of 3 metres (10 feet). It is available in three colours (pink, yellow and green), has large control buttons and it floats. The MP3 player is manufactured by Speedo, a global company well-known for its swimwear designs and accessories.

Figure 5: The Speedo MP3 Player

[Source: speedo.co.uk. Used with permission]

(a) (i) Outline **one** reason for the choice of colour range for the MP3 player. *[2]*

(ii) Outline why the MP3 player can be considered as an example of radical and incremental design. *[2]*

(b) (i) Describe the relationship of weight and mass to the use of the MP3 player. *[2]*

(ii) Explain why the forces acting on the MP3 player will vary when used whilst swimming and/or snorkelling. *[3]*

(c) (i) Outline **one** reason for designing the MP3 player so that it floats. *[2]*

(ii) Explain the criteria that consumers would apply to evaluate the MP3 player for value for money before purchase, during initial use and during long-term use. *[9]*