IB DIPLOMA PROGRAMME
PROGRAMME DU DIPLÔME DU BI
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M06/4/DESTE/HP2/ENG/TZ0/XX

22066202

DESIGN TECHNOLOGY
HIGHER LEVEL
PAPER 2

Thursday 18 May 2006 (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.

SECTION A

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

1. **Figure 1** shows a folding bicycle at the back of a Mini car with an upward opening rear door. **Figure 2** and **Figure 3** show more detail of a different model of folding all-terrain bicycle that the owner of the car rides. The frame of the bicycle is made of extruded metal tubing, mostly with a circular cross-section. However, the cross bar (see **Figure 2**) of the bicycle is made from rounded rectangular cross-sectional tubing.

Figure 1: Back of Mini car with upward opening rear door

Figure 2: Unfolded all-terrain bicycle

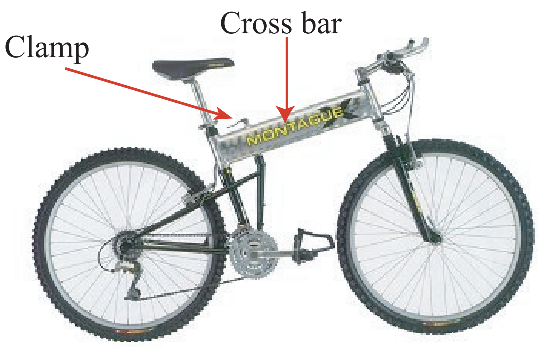

Figure 3: Folded all-terrain bicycle

Table 1: Data for the all-terrain bicycle shown in **Figure 2** and **Figure 3** (mm).

	Unfolded	Folded
Length	1600	970
Height	1100	850
Width	420	300

Table 2: Car rear storage area data (mm)

Make	Smart car	Mini
Rear door width	1025	1010
Rear door height	1055	1040
Depth of floor space	700	1050

(This question continues on the following page)

(Question 1 continued)

(a) (i) State the dimensions (in metres) of the smallest rectangular box that the folded bicycle shown in Figure 3 could be delivered in. *[1]*

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(ii) List **two** actions, apart from the actual folding, required to fold the bicycle as shown in Figure 3. *[2]*

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(iii) State whether the folded bicycle in Figure 3 can be laid flat in the storage area of either the Mini **and/or** the Smart Car. *[1]*

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(b) (i) Describe the importance of stiffness in the design of the frame of the bicycle shown in Figure 2. *[2]*

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(ii) Outline **one** way in which using metal tubing of rounded rectangular cross-section for the cross bar of the bicycle enhances the stiffness of the frame. *[2]*

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(Question 1 continued)

(c) (i) List **two** advantages of using extrusion for the manufacture of the metal tubing for the frame of the bicycle. *[2]*

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(ii) Describe why the design of this folding bicycle is an example of incremental design. *[2]*

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Table 3 shows the range of bicycle frame sizes produced by two manufacturers, A and B.

Table 3: Recommended bicycle frame sizes (in inches) for two manufacturers

Rider height (cm)	Manufacturer A	Manufacturer B
160	16	15
170	16	16
180	16	17
190	20	18
200	20	19
210	20	20

(d) (i) State how many frame sizes Manufacturer A needs to produce to cover the full range of rider heights from 160 cm to 210 cm. *[1]*

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(ii) Explain the disadvantage to Manufacturer B of producing an increased number of frame sizes to cover the range of rider heights from 160 cm to 210 cm. *[3]*

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(Question 1 continued)

(e) (i) List **two** ways in which the manufacturers might ensure that for any given frame size that the bicycle safely and comfortably accommodates its rider. *[2]*

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(ii) State **one** advantage and **one** disadvantage of a user trial in collecting ergonomic data for bicycle design. *[2]*

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2. (a) Define *lamination*. *[1]*

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(b) Discuss the advantage of using lamination as a manufacturing technique. *[3]*

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3. (a) State **one** way in which mild steel can be treated to prevent rusting. *[1]*

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(b) Explain why cotton is treated to make it suitable for use in various applications. *[3]*

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4. (a) Define *electrical resistivity*. *[1]*

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(b) Explain why an electrical wall socket uses materials with different electrical resistivities. *[3]*

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5. (a) Describe how designers use brainstorming in the development of a design. *[2]*

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(b) Compare divergent and convergent thinking. *[2]*

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6. (a) Define *planned obsolescence*. *[1]*

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(b) Explain how designing for planned obsolescence influences a designer's choice of materials. *[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 4** shows a 3-D freehand drawing of a hairdryer design and **Figure 5** a final product. The body of the hairdryer is made from a thermoplastic material and manufactured by injection moulding.

Figure 4: 3-D freehand drawing of a hairdryer

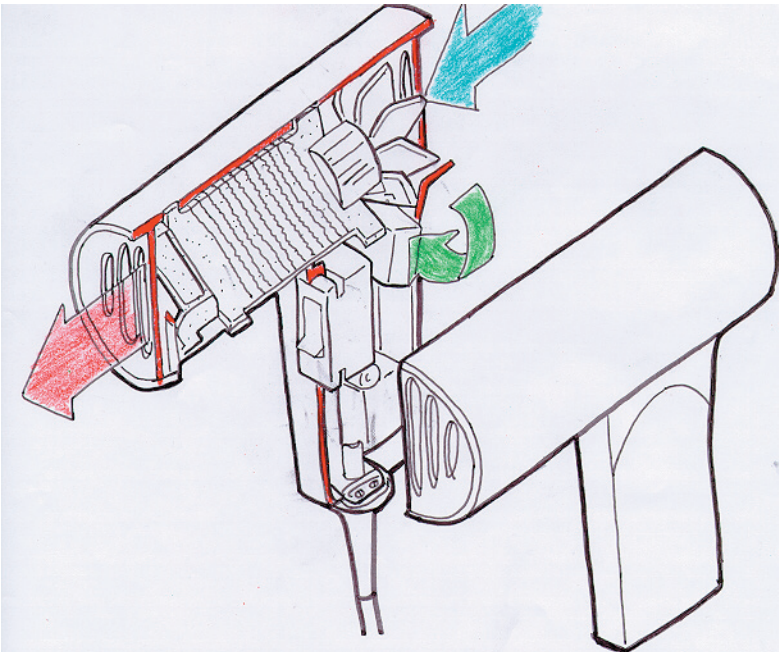

Figure 5: Hairdryer

(a) (i) List **two** advantages of 2-D and 3-D freehand drawings to designers. *[2]*

(ii) Explain why designers use a variety of drawing and modelling techniques to represent ideas. *[3]*

(b) (i) List **two** reasons for the selection of a thermoplastic for the manufacture of the body of the hairdryer. *[2]*

(ii) Describe the structure and bonding of a thermoplastic. *[2]*

(c) (i) Outline **one** way in which injection moulding can be considered as an example of a clean technology. *[2]*

(ii) Discuss **three** ways in which the design of the hairdryer could be modified to minimise its environmental impact – one relating to production, one relating to utilization and one relating to disposal. *[9]*

8. Renewable energy projects are becoming increasingly viable – not only in industrialised coutries, but also for the electrification of developing countries. **Figure 6** is a photograph of a renewable energy project.

Figure 6: A renewable energy project/wind farm

(a) (i) Outline **one** aspect of wind generators for which constructive discontent might be relevant. *[2]*

(ii) Annotate a simple input-process-output model to explain the process of converting wind energy into electrical energy. *[3]*

(b) (i) List **two** fixed costs relating to the wind farm. *[2]*

(ii) List **two** variable costs relating to the wind farm. *[2]*

(c) (i) List **two** characteristics of appropriate technology which are met by supplying energy using wind generators/wind farms. *[2]*

(ii) Discuss **three** issues involved in the development of a policy for the introduction of a large-scale wind farm such as the one shown in Figure 6, one at a community level, one at national level and one at international level. *[9]*

9. **Figure 7** shows a stainless steel tumble dryer and **Figure 8** the robotic assembly line for the volume production of such dryers. The production line automatically assembles and joins the front and side stainless steel panels of the tumble dryer and its plastic top.

Figure 7

Figure 8

(a) (i) List **two** advantages of automating the volume production of tumble dryers. *[2]*

(ii) Explain how industrial robots offer greater flexibility to automated production systems. *[3]*

(b) (i) Describe a metallic bond. *[2]*

(ii) State **one** advantage and **one** disadvantage of using stainless steel for the panels of the tumble dryer. *[2]*

(c) (i) Describe how the selection of a specific joining process for joining the stainless steel sides of the tumble dryer to its plastic top affects the ease of recycling of the tumble dryer on disposal at the end of its life cycle. *[2]*

(ii) Explain **three** ways that automated production impacts on the workforce and working conditions. *[9]*