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PROGRAMME DU DIPLÔME DU BI
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M07/4/DESTE/HP2/ENG/TZ0/XX

22076202

DESIGN TECHNOLOGY
HIGHER LEVEL
PAPER 2

Thursday 10 May 2007 (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 labelled drinks bottle (diameter of bottle base – 70 mm). The lower label wraps exactly half way round the base of the bottle. **Figure 2** shows a can. The bottle and the can are labelled in different ways:

- the bottle is labelled with self-adhesive labels supplied on rolls of 36 000 labels and applied while the contents of the bottles are cold. The adhesive used on the labels is water-soluble.
- the can is labelled while the contents are hot using a thermoset material as an adhesive. The adhesive is applied during the canning process (see **Figure 3**).

Figure 1: Drinks bottle

Figure 2: Can

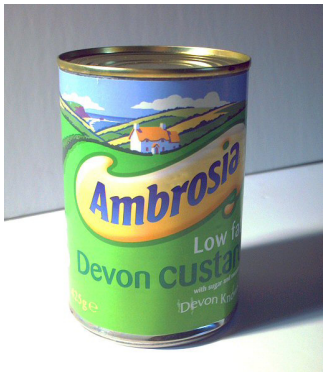

Figure 3: Label for can showing the thermoset adhesive on the inside of the label

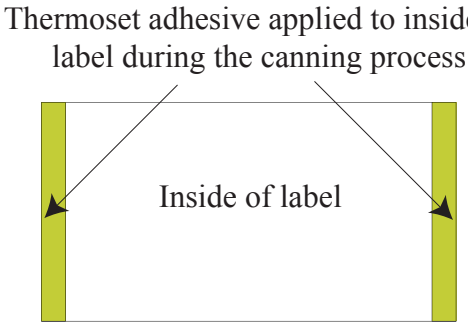

Table 1: Production line data for the bottling plant

Production line running speeds	100 to 440 glass bottles/minute
Length of one work shift	8 hours

(This question continues on the following page)

(Question 1 continued)

(a) (i) Calculate the length of the self-adhesive label required for the base of the bottle shown in Figure 1 ($\pi = 3.14$). *[1]*

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(ii) Calculate how many rolls of labels would be required for each work shift when the production line is running at maximum speed. *[3]*

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(b) (i) Identify **one** visual check that might be used to monitor the labelling process for the can. *[1]*

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(ii) Outline **one** reason why a thermoset adhesive not a thermoplastic adhesive is used to fix the label to the can. *[2]*

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(iii) Outline **one** advantage of using a water-soluble adhesive for the self-adhesive label for the glass bottle. *[2]*

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(c) Explain why the labelling process for the can is much more complex than the labelling process for the bottle. *[3]*

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(Question 1 continued)

Figure 4 shows the shipping carton for transporting 12 bottles. The internal separation for the carton is formed from 5 mm thick corrugated cardboard. **Figure 5** shows one of the cardboard shapes used – the shapes have slits cut out to enable them to interlock and form the separation. Each bottle (70 mm diameter) fits tightly into a compartment.

Figure 4: Shipping carton showing internal separation

Figure 5: Component for internal separation

Table 2: Bottle data

	Glass	Plastic
Cost per 1000 bottles	30 $	14 $
Weight of one full bottle	600 g	515 g

(d) (i) Calculate the total length of cardboard material required to form the internal separation for one case. *[2]*

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(ii) Draw, in the correct orientation, the second cardboard divider shape that would be required to complete the internal separation for the shipping carton. *[2]*

(e) (i) Calculate the cost advantage to the manufacturer, per 1000 cases, of using plastic bottles rather than glass bottles. *[2]*

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(Question 1(e) continued)

(ii) List **two** advantages of distributing drinks in plastic rather than glass bottles, other than cost, for use on an aircraft for in-flight meals. *[2]*

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2. (a) Define *thermal expansion*. *[1]*

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(b) Explain **one** design context where thermal expansion is an important consideration. *[3]*

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3. (a) Outline **one** reason for a manufacturer to evaluate a product prototype prior to going into volume production. *[2]*

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(b) Outline **one** strategy for evaluating the usability of a product. *[2]*

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4. (a) List **two** raw materials used to make glass. *[2]*

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(b) Compare the effect of impact on toughened and laminated glass. *[2]*

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5. (a) List **two** materials, apart from paper, glass and steel, that can be easily and economically recycled. *[2]*

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(b) State **one** green design strategy and a product to which that strategy could be applied. *[2]*

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6. (a) State **one** characteristic of an appropriate technology. *[1]*

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(b) Explain how energy considerations may have influenced the design of a named consumer product. *[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. A skateboarder in action is shown in **Figure 6**. Skateboard designers have tried various combinations of materials in the production of skateboards. For most skateboards the decks are made by lamination. The trucks are usually made by casting, using a batch production technique, from an aluminium alloy. The wheels are usually manufactured from nylon using injection moulding.

Figure 6: A skateboarder in action

[Source: www.720ice.com]

(a) (i) Outline **one** mechanical property that would make a material suitable for skateboard deck manufacture. *[2]*

(ii) Explain **one** disadvantage of producing a skateboard deck by lamination. *[3]*

(b) (i) Outline **one** property of nylon that makes it suitable for injection moulding of the wheels for the skateboard. *[2]*

(ii) Describe how one-off production contributes to the batch production of the trucks. *[2]*

(c) (i) Outline **one** way in which using standardised components contributes to green design strategies. *[2]*

(ii) Discuss **three** implications, one for the designer, one for the manufacturer and one for the user, of using standardised components in the truck design. *[9]*

8. **Figure 7** shows an MP3-type music player which can be used to download music from the Internet. The outer case is made from a thermoplastic. The rapid pace of change in products of this type is likely to mean that the player shown in **Figure 7** will have a short product life. However, despite this the player claims to be consistent with sustainable development.

Figure 7: MP3 player

(a) (i) Outline **one** property of a thermoplastic that makes it suitable for injection moulding of components of the MP3 player shown in Figure 7. *[2]*

(ii) Explain **one** economic reason why injection moulding is used for the volume production of thermoplastic components for the MP3 player shown in Figure 7. *[3]*

(b) (i) Outline **one** aspect of the design of the MP3 player shown in Figure 7 which has been influenced by anthropometric considerations. *[2]*

(ii) Outline **one** aspect of the design of the MP3 player shown in Figure 7 which has been influenced by ergonomic considerations. *[2]*

(c) (i) Outline the stage in its product life cycle that MP3 players as consumer products are currently at. *[2]*

(ii) Explain **three** product characteristics that the MP3 player in Figure 7 needs to have to be considered consistent with sustainable development. *[9]*

9. **Figure 8** shows an adapted model of a standard refrigerator. The door of the refrigerator has been fitted with a touch screen and a bar-code scanner. The refrigerator allows access to the Internet and enables a database of the contents of the refrigerator to be continuously maintained. It enables users to order groceries, play games, read email and watch television, as well as keeping food fresh.

Figure 8: Refrigerator comprising touch screen and bar-code scanner

(a) (i) List **two** considerations in the design of the refrigerator that would minimize its environmental impact on disposal. *[2]*

(ii) Outline **one** stage in the product life cycle at which designing the refrigerator to use less energy will have the greatest benefit for the environment. *[2]*

(b) (i) Describe why the refrigerator is an example of incremental design. *[2]*

(ii) Explain **one** advantage of undertaking a user trial at the prototype stage of the development of the refrigerator. *[3]*

(c) (i) List **two** lifestyle changes that this product would be likely to promote in its users. *[2]*

(ii) Explain **three** strategies that the designer could consider to overcome early obsolescence of the computer and the body of the refrigerator. *[9]*