M05/4/DESTE/SP2/ENG/TZ0/XX+

22056205

DESIGN TECHNOLOGY
STANDARD LEVEL
PAPER 2

Wednesday 4 May 2005 (afternoon)

1 hour

Candidate session number

0	0								

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. Crowd safety is a major consideration in the design of sports grounds, especially in areas used for standing spectators. **Figure 1** is a plan of a terraced stand with steps which have a tread depth of 380mm (see **Figure 2**). **Figure 3** shows a section through the stand fitted with crush barriers for crowd control. The crush barriers are designed to accommodate adult spectators and are 1.1 metres high (see **Figure 2**) so they press against parts of the body best able to withstand pressure. The barriers must be able to withstand horizontal loads of 5.0 kN/m. The maximum horizontal spacing between crush barriers depends on the angle of the slope and is shown in **Table 1**. The area behind the crush barriers determines the maximum number of spectators allowed in the stand. The recommended density is 47 spectators per 10 square metres of available viewing area. A bank of turnstiles, each of which allows 660 people to enter every hour, controls entry to the stand.

Figure 1: Plan of terraced section of sports ground (not to scale)

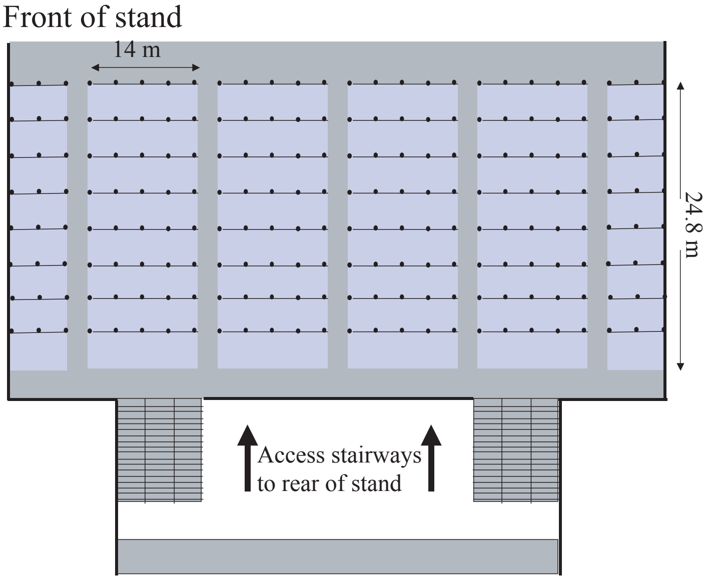

Figure 2: Positioning crush barriers on the terrace steps. (a) back of the step; (b) at the front of step; (c) in the centre of the step.

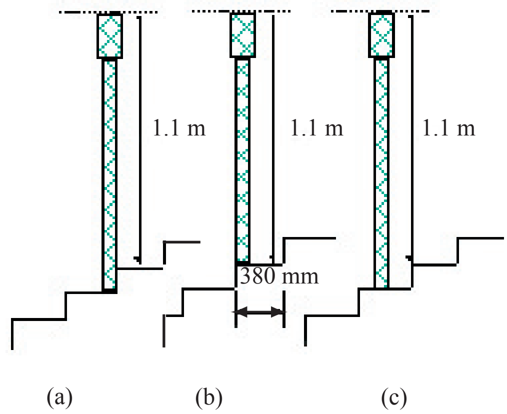

Figure 3: Section through terraced stand angled at 25° (not to scale)

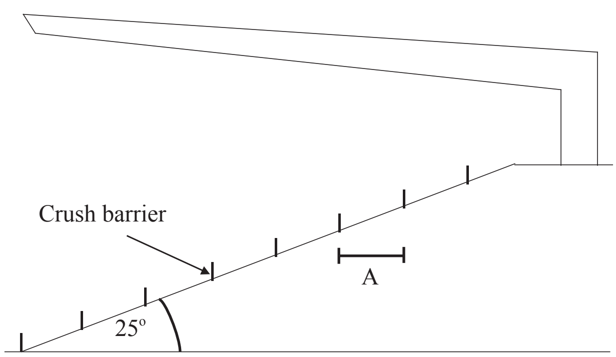

Table 1: Maximum horizontal spacing between crush barriers

Angle of terrace	Maximum horizontal spacing between crush barriers (m) (See distance A on Figure 3)			
5°	5.0	4.0	3.0	2.0
10°	1.3	3.4	2.6	1.7
15°	3.8	3.0	2.3	1.5
20°	3.4	2.7	2.0	1.3
25°	3.1	2.5	1.8	1.2
horizontal load	5.0 (kN/m)	4.0 (kN/m)	3.0 (kN/m)	2.0 (kN/m)

(This question continues on the following page)

(Question 1 continued)

(a) (i) State the maximum horizontal spacing between crush barriers for the terrace. *[1]*

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. . . .

(ii) State **one** reason why (c) in Figure 2 is a less suitable position for the crush barrier than (a) or (b). *[1]*

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(iii) Calculate the number of steps there will be between the crush barriers if they are positioned as in Figure 2 (a) and at the maximum horizontal spacing. *[2]*

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(iv) Outline **one** reason why additional guarding must be provided on the crush barriers if children are allowed into the standing area. *[2]*

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(b) (i) Calculate the area behind the crush barriers available to spectators. *[2]*

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(ii) Calculate the maximum capacity of the stand. *[2]*

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(iii) Calculate the number of banks of turnstiles required to enable the total number of spectators to enter the stand in one hour. *[2]*

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2. (a) Define *tensile strength*. *[1]*

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(b) Explain **one** design context in which tensile strength is an important consideration. *[3]*

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3. (a) Define *cost-effectiveness*. *[1]*

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(b) Explain the key factors that determine the final cost of a product. *[3]*

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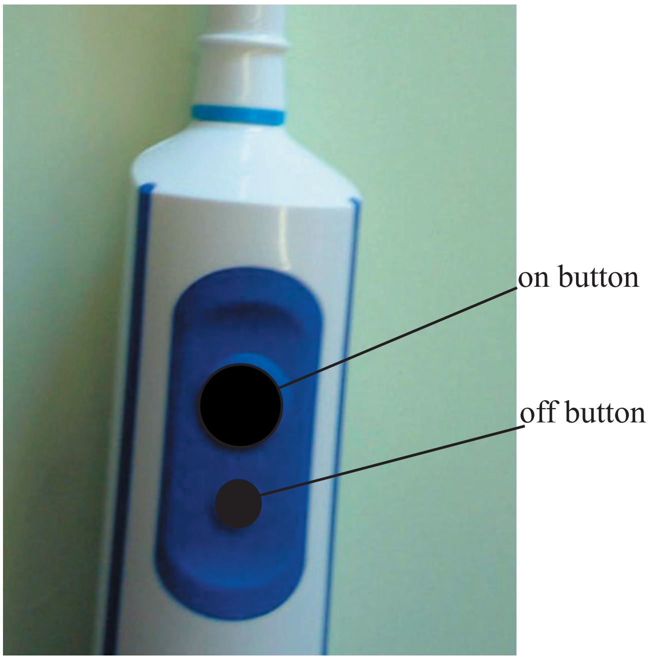
SECTION B

*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.*

4. **Figure 4** shows a person testing a new model of electric toothbrush in a user trial. The body of the toothbrush is made of a white thermoplastic. **Figure 5** shows the on and off switches of the electric toothbrush which is covered by a second blue thermoplastic material which is fused to the main body of the unit.

Figure 4: Electric tooth brush

Figure 5: Switch cover



(a) (i) Define *user trial*. *[1]*

(ii) Outline **one** advantage of using a user trial in the development of the electric toothbrush. *[2]*

(iii) Outline **one** disadvantage of using a user trial in the evaluation of the electric toothbrush. *[2]*

(b) (i) Describe the significance of stiffness in the selection of the plastic materials for the body of the electric toothbrush and the switch cover. *[2]*

(ii) Outline **one** reason why fusing is an appropriate method for joining the two types of plastic. *[2]*

(c) (i) Outline **one** way in which consideration of planned obsolescence would influence the design specification of the electric toothbrush. *[2]*

(ii) Discuss how the strategies of reuse, repair and recycle **could** be applied in the design of the electric toothbrush. *[9]*

5. The original ballpoint pen was developed and launched in 1938 by Bíró. Working as a journalist in Budapest, Bíró noticed that the ink used for printing newspapers dried quickly so it did not smudge. Printing ink was thicker and did not flow from ordinary pen nibs, so Bíró developed a pen with a tiny ball-bearing in its tip (see **Figure 6**). The ball-bearing rotates as it moves along the paper, moving ink from the cartridge onto the paper. Today, ballpoint pen bodies (see **Figure 7**) are often made of a thermoplastic material that is injection-moulded and would be marked up with an appropriate symbol (see **Figure 8**) to indicate the material from which the pen body is made.

Figure 6: A ballpoint pen tip

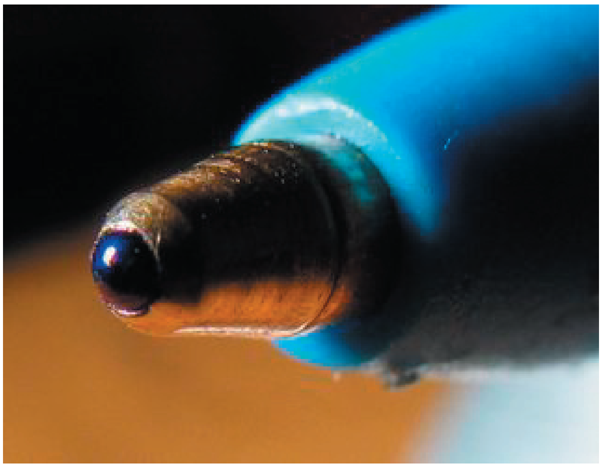


Figure 7: Injection-moulded ballpoint pen bodies

Figure 8: Symbol indicating pen body material

(a) (i) Define *product cycle*. *[1]*

(ii) Describe the role of constructive discontent in the early stages of the development of the ballpoint pen. *[2]*

(iii) Outline **one** reason why the ballpoint pen can be considered as being in the mature stage of its product life cycle. *[2]*

(b) (i) List **two** advantages of injection moulding in the production of the ballpoint pen body. *[2]*

(ii) List **two** mechanical properties that makes a material suitable for injection moulding. *[2]*

(c) (i) Describe how the symbol shown in Figure 8 facilitates recycling. *[2]*

(ii) Explain **three** ways in which the adoption of a proactive environmental policy can help increase profits for the ballpoint pen manufacturer. *[9]*

6. **Figure 9** shows the entrance to a shop in a new shopping centre that was built following extensive public consultation with local residents. To delineate the pedestrian walkway from the driveway for cars a line of bollards has been placed along the edge of the walkway (see **Figure 10**). The upright sections of the bollards are produced by extrusion from a corrosion-resistant metal and the tops are fused onto the upright section to finish the bollards.

Figure 9: Shop entrance

Figure 10: Safety bollards

(a) (i) State **one** drawing technique that could be used to communicate proposals for the design of the shopping centre to local residents during the public consultation process. *[1]*

(ii) State **one** advantage and **one** disadvantage of using a physical model of the shopping centre in the consultation process. *[2]*

(iii) Outline **one** factor that influences the spacing of the bollards. *[2]*

(b) (i) Outline **one** property that makes a material suitable for extrusion. *[2]*

(ii) List **two** advantages of extrusion for the manufacture of the upright sections of the bollards. *[2]*

(c) (i) Outline **one** aspect of the design of the bollards that makes them suitable for application in this public access area of the shopping centre. *[2]*

(ii) Explain how automation, batch production and craft production would be incorporated into the production and installation of the safety bollards. *[9]*