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DESIGN TECHNOLOGY
STANDARD LEVEL
PAPER 3

Candidate session number

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Tuesday 19 November 2013 (morning)

1 hour

Examination code

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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.
- Answer all of the questions from one of the Options.
- Write your answers in the boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is *[30 marks]*.

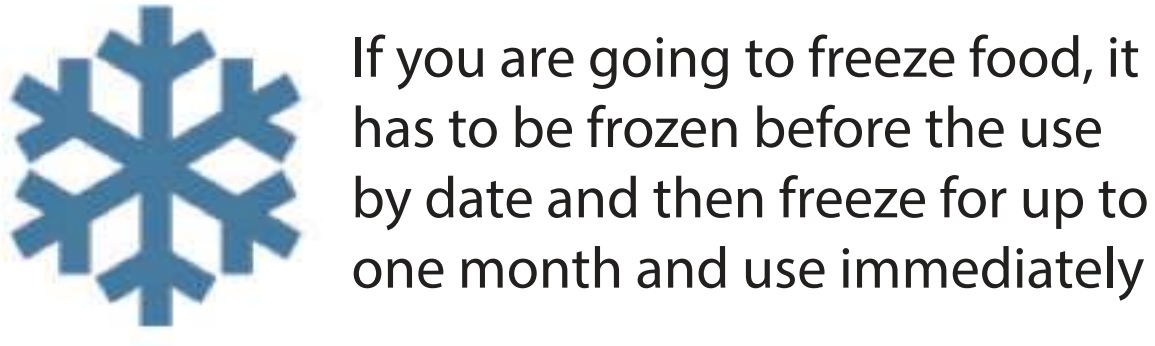
Option	Questions
Option A — Food science and technology	1–6
Option B — Electronic product design	7–12
Option C — CAD/CAM	13–18
Option D — Textiles	19–24
Option E — Human factors design	25–30

33 pages

Option A — Food science and technology

1. **Figure A1** shows the new guidance offered to consumers for freezing fresh food. Previous guidance was to freeze food on the day of purchase only. It is estimated that the new labelling advice could stop enormous amounts of food being wasted each year.

Figure A1: New labelling guidance relating to the freezing of food



[Source: Image: http://en.wikipedia.org/wiki/File:Snow_flake.svg
Text: http://www.j-sainsbury.co.uk/media/445015/freezing_guidelines_on_pack_520.jpg.]

(a) State **one** reason for freezing food apart from reducing waste. *[1]*

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(b) Outline **one** reason why it is recommended that when frozen food is defrosted it should be used on the same day. *[2]*

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(Option A continues on the following page)

(Option A, question 1 continued)

(c) Explain **one** benefit of the new labelling advice apart from stopping enormous amounts of food being wasted each year. *[3]*

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2. (a) State **one** category of person for whom body mass index (BMI) can be misleading. *[1]*

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(b) List **two** reasons why acceptable ranges of BMI for health may vary in different parts of the world. *[2]*

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(Option A continues on the following page)

(Option A continued)

3. **Figure A2** shows a bottle of Powerade – a sports drink designed for use after intense exercise. It is produced by the Coca-Cola® company. Powerade mainly comprises sugar and water with minerals (sodium and potassium) and B vitamins.

Figure A2: Powerade sports drink

Figure A2 removed for copyright reasons

(a) Describe the importance of B vitamins for athletes. *[2]*

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(b) Describe why the minerals sodium and potassium are important for athletes. *[2]*

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(Option A continues on the following page)

(Option A continued)

4. Describe the importance of the product design brief in driving the design of new food products. *[2]*

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5. Explain **two** types of food spoilage. *[6]*

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(Option A continues on the following page)

(Option A continued)

6. Explain **three** ways in which on-farm processing can enhance the sustainability of the rural economy. *[9]*

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End of Option A

Please **do not** write on this page.

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Option B — Electronic product design

7. **Figure B1** shows a quad logic chip with four identical digital logic gates.

Figure B1: Chip with four identical digital logic gates

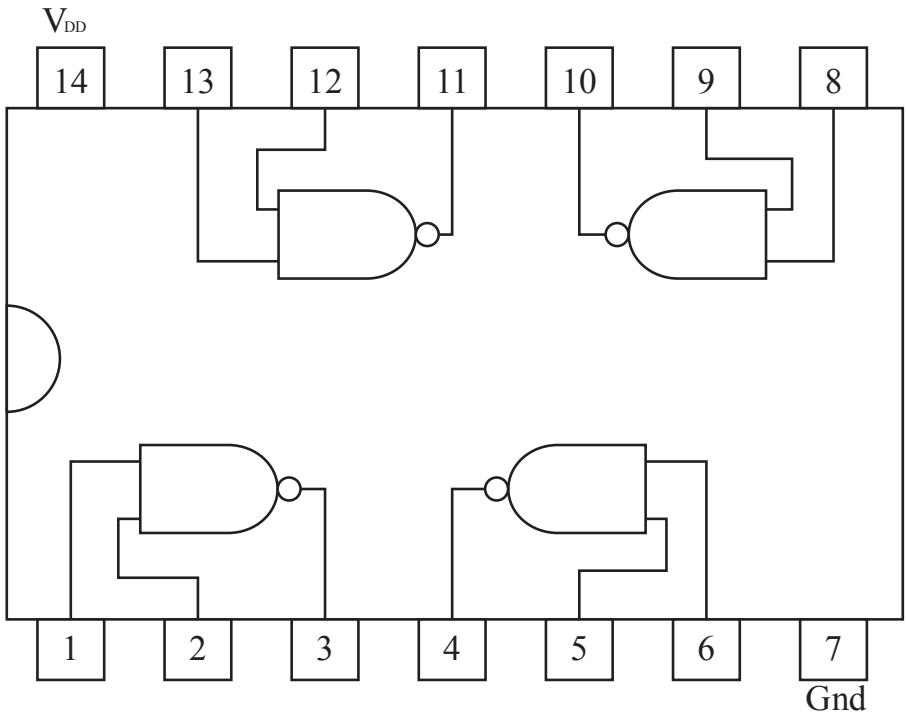
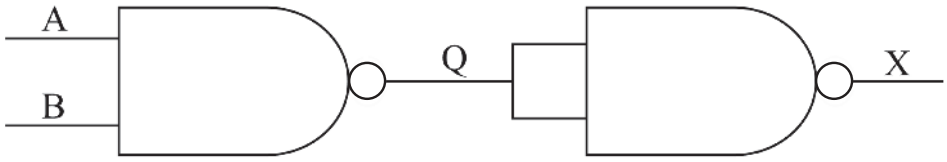


Figure B2: Logic circuit comprising two digital logic gates on the chip shown in Figure B1



(Option B continues on the following page)

(Option B, question 7 continued)

(a) State the type of digital logic gate on the chip shown in **Figure B1**. *[1]*

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(b) Complete the truth table shown below for the circuit in **Figure B2**. *[2]*

A	B	Q	X
0	0		
0	1		
1	0		
1	1		

(c) Explain **one** reason why a manufacturer might decide to use the quad logic chip shown in **Figure B1** in circuit design. *[3]*

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(Option B continues on the following page)

(Option B continued)

8. (a) State **one** way in which programmable interface controllers (PICs) can extend the product life cycle. *[1]*

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(b) Outline **one** way that programmable interface controllers have contributed to an increase in the portability of electronic products. *[2]*

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(Option B continues on the following page)

(Option B continued)

9. **Figure B3** shows a voltage divider. It comprises two resistors R_1 and R_2. R_2 is marked with brown, green, orange and gold bands.

Figure B3: Voltage divider

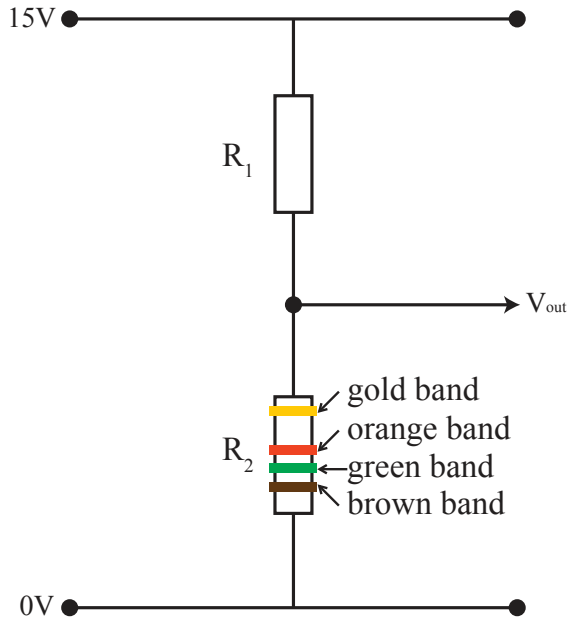

Table B1: Resistor colour coding

Color	Value
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Grey	8
White	9
Gold	± 5 %

(a) Calculate the range within which the resistance of R_2 lies. *[2]*

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(b) Calculate the ratio of R_1 to R_2 to achieve an output voltage of 10 volts. *[2]*

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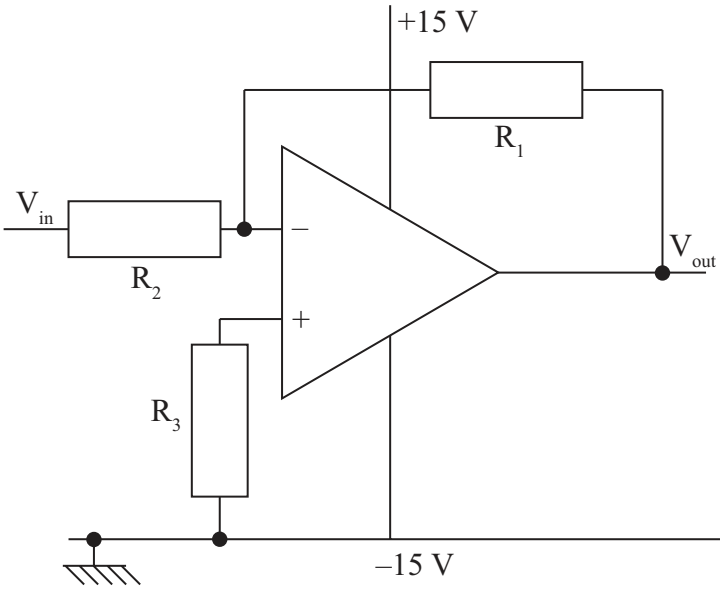
(Option B continues on the following page)

(Option B continued)

10. Calculate the gain of the operational amplifier circuit shown in **Figure B4** if R_1 is 220 kΩ and R_2 and R_3 are each 22 kΩ. *[2]*

Figure B4: Operational amplifier circuit



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(Option B continues on the following page)

(Option B continued)

11. Explain **two** criteria for an appropriate solution for the supply of electricity to communities in remote areas of developing countries. *[6]*

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(Option B continues on the following page)

(Option B continued)

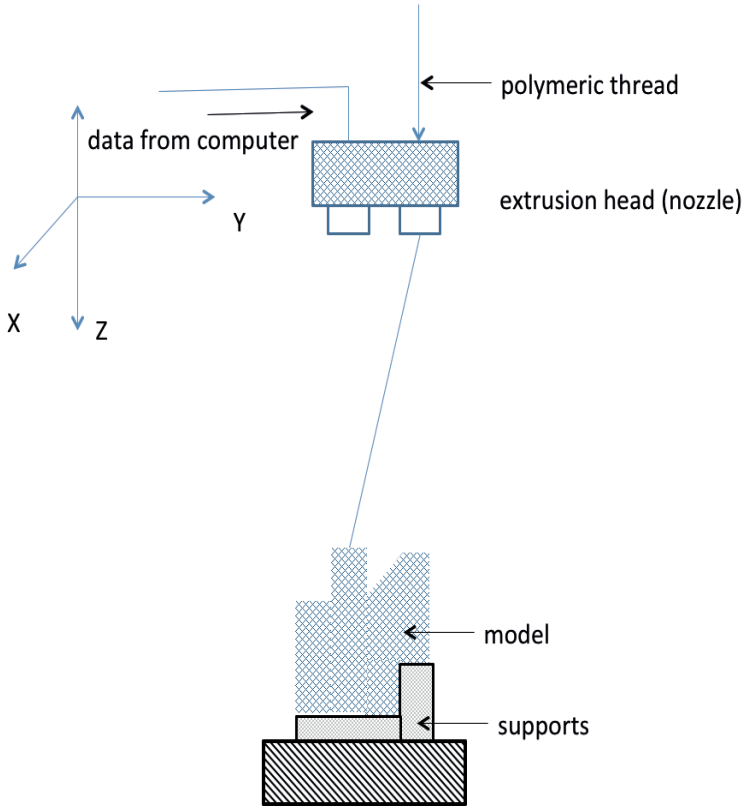
12. Discuss **three** considerations for installing a copper wire network in comparison to a fibre optic network. *[9]*

End of Option B

Option C — CAD/CAM

13. **Figure C1** shows a schematic 2D diagram of fuse deposition modelling (FDM) rapid prototype manufacture.

Figure C1: Schematic 2D diagram of the FDM process



[Source: © International Baccalaureate Organization 2014]

(a) State **one** advantage to the designer of using FDM rapid prototype manufacturing technology. *[1]*

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(Option C continues on the following page)

(Option C, question 13 continued)

(b) Describe the function of the extrusion head in the FDM process shown in **Figure C1**. *[2]*

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(c) Explain **one** reason why support material is required when using FDM rapid prototype manufacture as shown in **Figure C1**. *[3]*

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(Option C continues on the following page)

(Option C continued)

14. (a) State **one** disadvantage of subtractive manufacturing techniques for the environment. *[1]*

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(b) Outline **one** advantage of a laser cutter over a plotter cutter. *[2]*

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15. (a) Outline **one** advantage of a computer-integrated manufacturing (CIM) system for consumers. *[2]*

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(b) Outline **one** disadvantage of adopting a CIM system for a small manufacturing company. *[2]*

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(Option C continues on the following page)

(Option C continued)

16. Outline **one** advantage of finite element analysis (FEA) to designers when choosing a suitable material for a load-bearing structure. *[2]*

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(Option C continues on the following page)

(Option C continued)

17. **Figure C2** shows a video snapshot of a virtual walk-through of the apartment.

Figure C2: Video snapshot of a virtual walk-through of an apartment

Figure C2 removed for copyright reasons

Explain **two** advantages to the consumer of using virtual reality software in designing new buildings. *[6]*

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(Option C continued)

18. Explain **three** ways in which CAD/CAM has impacted on the market for furniture from a consumer perspective. *[9]*

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End of Option C

Option D — Textiles

19. The red line on the map in **Figure D1** shows the original route of the "Silk Road" from 100 BCE.

Figure D1: Map showing the original route of the "Silk Road" as a red line

Figure D1 removed for copyright reasons

(a) State **one** reason why the Chinese had a monopoly of silk production for about 3000 years. *[1]*

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(Option D continues on the following page)

(Option D, question 19 continued)

(b) Outline **one** way in which the "Silk Road" could be considered the information superhighway of its day. *[2]*

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(c) Explain **one** reason for the continued popularity of silk for clothing. *[3]*

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(Option D continues on the following page)

(Option D continued)

20. (a) State **one** characteristic of a woven fabric. *[1]*

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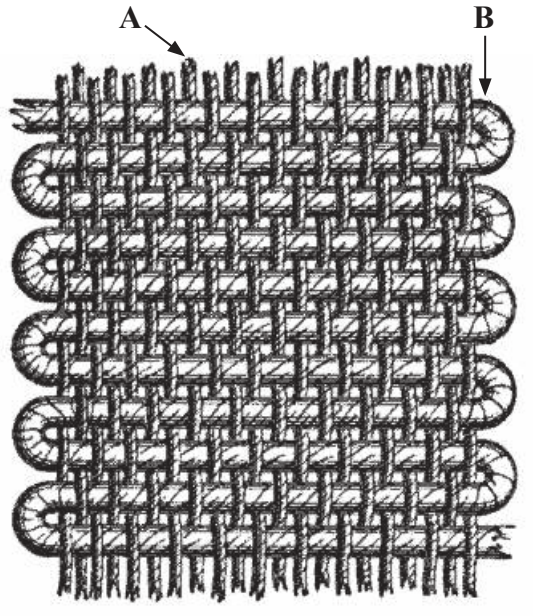
(b) State the names of threads **A** and yarn **B** in **Figure D2**. *[2]*

Figure D2: A woven fabric



[Source: http://en.wikipedia.org/wiki/File:Warp_and_weft.jpg]

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(Option D continues on the following page)

(Option D continued)

21. **Figure D3** shows a hat that is made from 100 % Alpaca wool. It is knitted by hand in Peru and is sold online via the Internet for US$45.99.

Figure D3: A hat made from Alpaca wool

[Source: Peruhandicraft.com. Used with permission.]

(a) Outline **one** reason why the hat is made by hand. *[2]*

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(b) Outline **one** way that the design of the hat could be modified to reduce its cost of manufacture. *[2]*

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(Option D continues on the following page)

(Option D continued)

22. Outline **one** advantage of using adhesives for joining two pieces of fabric. *[2]*

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(Option D continues on the following page)

(Option D continued)

23. **Figure D4** shows two cyclists wearing garments made from Lycra®.

Figure D4: Cyclists wearing Lycra® apparel

[Source: http://en.wikipedia.org/wiki/File:Barney_Storey_and_Neil_Fachie.jpg]

Explain **two** ways in which Lycra® has contributed to the enhanced performance of racing cyclists. *[6]*

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(Option D continues on the following page)

(Option D continued)

24. Explain **three** ways that the use of computerized manufacture in the textile industry has improved the quality of products. *[9]*

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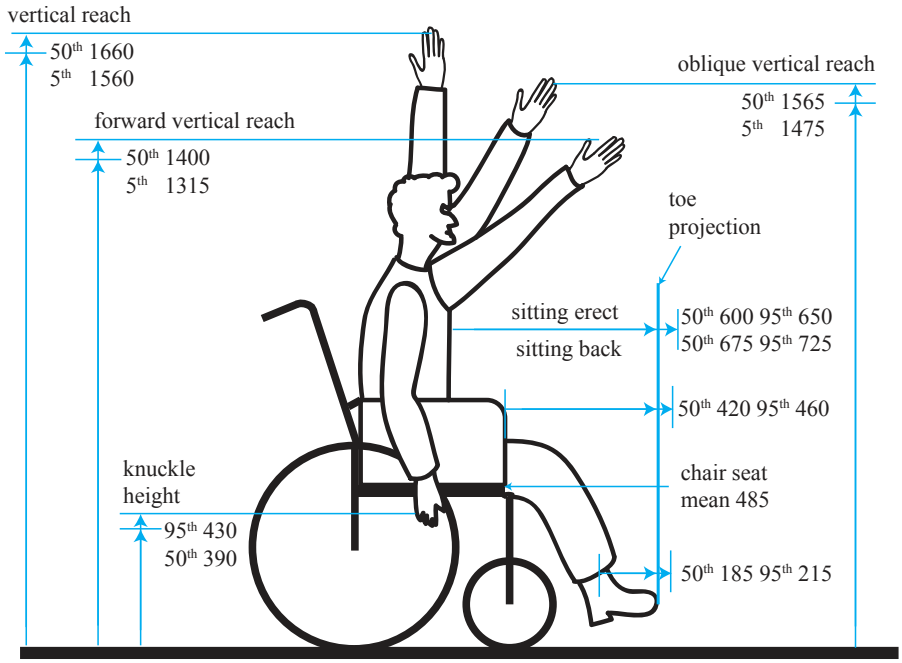
End of Option D

Option E — Human factors design

25. **Figure E1** shows percentile range data for adult male wheelchair users. All measurements are in millimetres.

Figure E1: Percentile range data for wheelchair users (mm)



[Source: © International Baccalaureate Organization 2014]

(a) State the type of data scale used for the data shown in **Figure E1**. *[1]*

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(b) Outline **one** reason why the 5th percentile is used in relation to each of the measurements associated with reach. *[2]*

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(Option E continues on the following page)

(Option E, question 25 continued)

(c) Explain why the data for toe projection is given in terms of the 50th and 95th percentiles. *[3]*

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26. (a) State **one** risk assessment strategy that would be used to identify patterns of behaviour preceding accidents. *[1]*

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(b) Describe the purpose of behavioural testing to determine adequate product safety. *[2]*

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(Option E continues on the following page)

(Option E continued)

27. Some people have difficulty opening ring pull cans with their fingers. **Figure E2** shows the Magipull ring pull can opener – a device designed to assist people to open ring pull cans.

Figure E2: The Magipull ring pull can opener

[Source: Culinare MagiPull Blue from DKB Household. Used with permission.]

(a) Outline **one** reason why people may have difficulty opening ring pull cans with their fingers. *[2]*

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(b) Outline **one** potential disadvantage of using the Magipull ring pull can opener for able-bodied people. *[2]*

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(Option E continues on the following page)

(Option E continued)

28. Describe how poor organization of a product's user interface imposes a memory burden on users. *[2]*

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(Option E continues on the following page)

(Option E continued)

29. **Figure E3** shows a range of cutlery called Sure grip bendable cutlery. The cutlery has large rubber handles and can be bent to suit the user (see **Figure E3** inset). **Figure E4** shows the Baroque range of cutlery manufactured from stainless steel.

Figure E3: Sure grip bendable cutlery

[Source: www.redlandhealthcare.co.uk]

Figure E4: Baroque cutlery

[Source: www.procook.co.uk]

Compare **two** human factor design features of the Sure grip bendable cutlery with those of the Baroque cutlery range. *[6]*

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(Option E continues on the following page)

(Option E continued)

30. Explain **three** advantages of paper prototyping in the design of the controls for electronic products. *[9]*

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End of Option E

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