



88146203

**DESIGN TECHNOLOGY
HIGHER LEVEL
PAPER 3**

Candidate session number

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Wednesday 19 November 2014 (morning)

Examination code

1 hour 15 minutes

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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 [40 marks].

Option	Questions
Option A — Food science and technology	1–7
Option B — Electronic product design	8–14
Option C — CAD/CAM	15–21
Option D — Textiles	22–28
Option E — Human factors design	29–35



40EP01

Option A — Food science and technology

1. **Figure A1** shows a bowl of homemade mayonnaise. The ingredients are shown in **Figure A2**. Mayonnaise is a food emulsion that is made by beating egg yolks, salt, mustard, sugar, pepper, lemon juice (or vinegar) and sunflower oil until it is very thick. The mayonnaise should be stored chilled in the refrigerator for no longer than one week.

Figure A1: A bowl of homemade mayonnaise



Figure A2: Ingredients for mayonnaise

- 2 egg yolks
- 5 g mustard
- 5 ml vinegar
- 100 ml sunflower oil
- 10 ml lemon juice (or vinegar)
- 3 g sugar
- Salt and freshly cracked black pepper (to taste)

[Source: http://commons.wikimedia.org/wiki/File:Fresh_mayonnaise.jpg]

- (a) State which ingredient listed in **Figure A2** acts as the emulsifying agent for the mayonnaise. [1]

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- (b) Describe the structure of a food emulsion, such as mayonnaise. [2]

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(Option A continues on the following page)



40EP02

(Option A, question 1 continued)

- (c) Explain why the mayonnaise should be stored chilled in the fridge. [3]

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2. (a) Define *genetically modified organism (GMO)*. [1]

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- (b) Outline **one** reason for the genetic modification of food crops. [2]

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(Option A continues on the following page)



(Option A continued)

3. **Figure A3** shows a picture of a stall in a farmers' market in Santiago, Chile.

Figure A3: A stall in a farmers' market in Santiago, Chile



[Source: © International Baccalaureate Organization 2015]

(a) Outline **one** advantage of farmers' markets, such as the one shown in **Figure A3**, to consumers. [2]

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(b) Outline **one** advantage of farmers' markets to farmers. [2]

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(Option A continues on the following page)



(Option A continued)

4. Explain how obesity and a food poisoning outbreak impact differently on health services. [6]

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(Option A continues on the following page)



40EP05

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(Option A continued)

5. (a) Describe how infective bacterial food poisoning is caused. [2]

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- (b) Describe how toxin-type bacterial food poisoning is caused. [2]

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- (c) Outline why cooking is ineffective in controlling toxin-type bacterial food poisoning. [2]

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(Option A continues on the following page)



(Option A continued)

6. (a) Explain the significance of poverty. [3]

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- (b) Explain the value of the human development index at a country level in the fight against poverty. [3]

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(Option A continues on the following page)



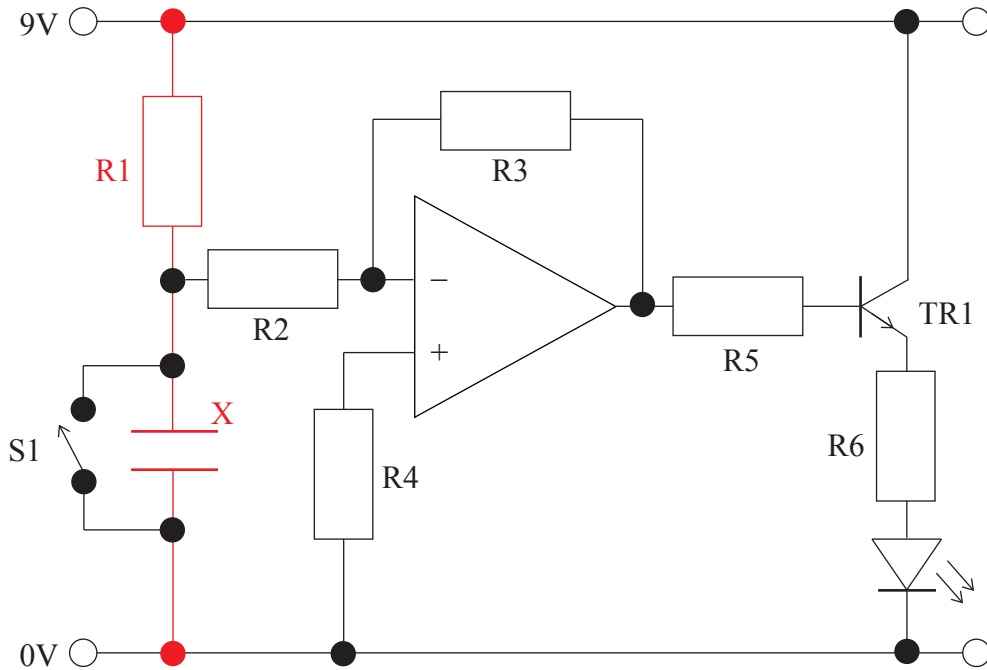
40EP07

Turn over

Option B — Electronic product design

8. Figure B1 shows a circuit to operate a time delay on an LED.

Figure B1: Circuit diagram



(a) State the type of the component labelled X in Figure B1. [1]

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(b) Describe the function of the R1-X combination (shown in red) in Figure B1. [2]

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(Option B continues on the following page)



Turn over

(Option B, question 8 continued)

- (c) Explain how the circuit shown in **Figure B1** works when the switch labelled S1 is open. [3]

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- 9. (a) Define *service costs*. [1]

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- (b) Outline **one** way in which service costs may encourage a consumer to replace an electronic product rather than repairing it. [2]

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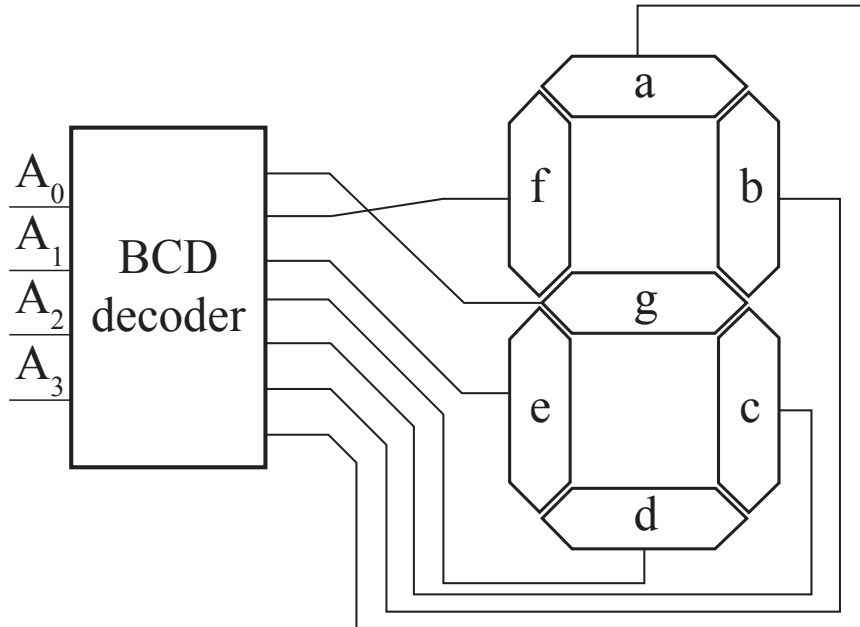
(Option B continues on the following page)



(Option B continued)

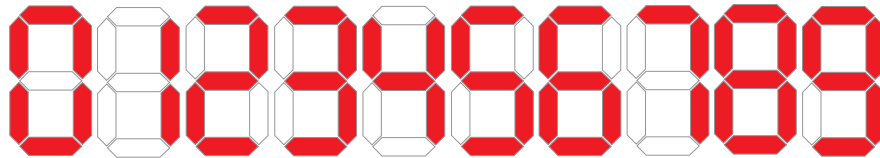
10. **Figure B2** shows a binary coded decimal (BCD) to seven-segment decoder. The segments are made of light-emitting diodes (LEDs). **Figure B3** shows the combinations of segments that result in the various digits from 0 to 9.

Figure B2: A binary coded decimal to seven-segment decoder



[Source: © International Baccalaureate Organization 2015]

Figure B3: 0–9 on a seven-segment display



[Source: © International Baccalaureate Organization 2015]

- (a) List **two** reasons for using LEDs for the segments of the seven-segment display. [2]

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- (b) Complete the truth table for the decimal number 7. [2]

Number	A ₃	A ₂	A ₁	A ₀	a	b	c	d	e	f	g
7											

(Option B continues on the following page)



40EP11

Turn over

(Option B continued)

- 11.** Explain how programmable interface controllers (PICs) can contribute to the implementation and on-going sustainability of hearing aids.

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(Option B continues on the following page)



40EP12

(Option B continued)

12. A designer is working on the automation of a bath for a smart home. The brief requires the bath system to operate a mixer tap valve so that the bath automatically fills to the right level (for example 75% full) with water at the right temperature (for example 38°C).

The brief also requires that the temperature of the water in the bath be maintained for as long as needed by the user.

The designer is debating between using a timer delay to fill the bath to the right level and finding a way to measure the actual depth of the water in the bath.

- (a) Describe how the automated bath system could be designed so that the mixer tap valve operates to fill the bath with water of the right temperature. [2]

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- (b) List **two** disadvantages of using a timer delay to determine the level of water in the bath in comparison to measuring the depth of water in the bath. [2]

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- (c) Describe, with the aid of an annotated diagram, how a closed loop control system would be used to maintain the temperature of the water in the bath. [2]

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(Option B continues on the following page)



40EP13

Turn over

(Option B continued)

13. (a) Explain **one** way in which product take-back legislation has impacted on the **design** of electronic products. [3]

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- (b) Explain **one** way in which take-back legislation has impacted on the **price** of electronic products. [3]

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(Option B continues on the following page)



Option C — CAD/CAM

- 15. The Chicago Architecture Foundation has built a model of the city (**Figure C1**). The 1000 buildings took 3000 hours to build using stereo lithography.

Figure C1: The Chicago Model City



[<http://chicagomodelcity.org>]

- (a) State **one** reason why the production of the model city’s buildings using stereo lithography resulted in very little waste. [1]

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- (b) Outline **one** advantage of choosing stereo lithography rather than fuse deposition modelling (FDM) to produce the model. [2]

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(Option C continues on the following page)



40EP16

(Option C, question 15 continued)

- (c) Suggest **one** possible method the Chicago Architecture Foundation may have used to generate the necessary CAD files for use with stereo lithography. [3]

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- 16. (a) State **one** characteristic of natural timber that may make it unsuitable for use with CAM. [1]

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- (b) Outline **one** precaution that a manufacturer would need to consider when using medium-density fibreboard (MDF) in a CAM system. [2]

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(Option C continues on the following page)



40EP17

Turn over

(Option C continued)

- 17. CAD software can be used for “top down” or “bottom up” modelling of parts, components and complete products, such as the Moon exploration vehicle and its wheels (**Figure C2**).

Figure C2: Exploded solid CAD model of a Moon exploration vehicle

Please go to the link: <http://www.rocketcityspacepioneers.com/space/lunar-rover-design-challenges—environmental-issues>

- (a) Outline **one** benefit of using “bottom up” modelling in the development of the solid CAD model of the Moon exploration vehicle. [2]

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- (b) Identify **one** limitation of surface modelling for rapid prototyping (RP) the model of the Moon exploration vehicle shown in **Figure C2**. [2]

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(Option C continues on the following page)



(Option C continued)

- 19. Petra Furniture Store specializes in the manufacture of solid wood furniture like the coffee table (**Figure C3**).

Figure C3: Solid wood coffee table



[Source: www.zientte.com]

- (a) Outline **one** disadvantage for manufacturers who replace a human workforce with robots for the production of the solid wood coffee table shown in **Figure C3**. [2]

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- (b) Outline **one** advantage of robots in batch production. [2]

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(Option C continues on the following page)



(Option C, question 19 continued)

- (c) Outline **one** reason why a manufacturer may combine robots with a human workforce to produce the solid wood coffee table shown in **Figure C3**. [2]

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- 20. (a) Discuss the effect of CAM systems on **employment**. [3]

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- (b) Discuss the effect of CAM systems on **work patterns**. [3]

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40EP21

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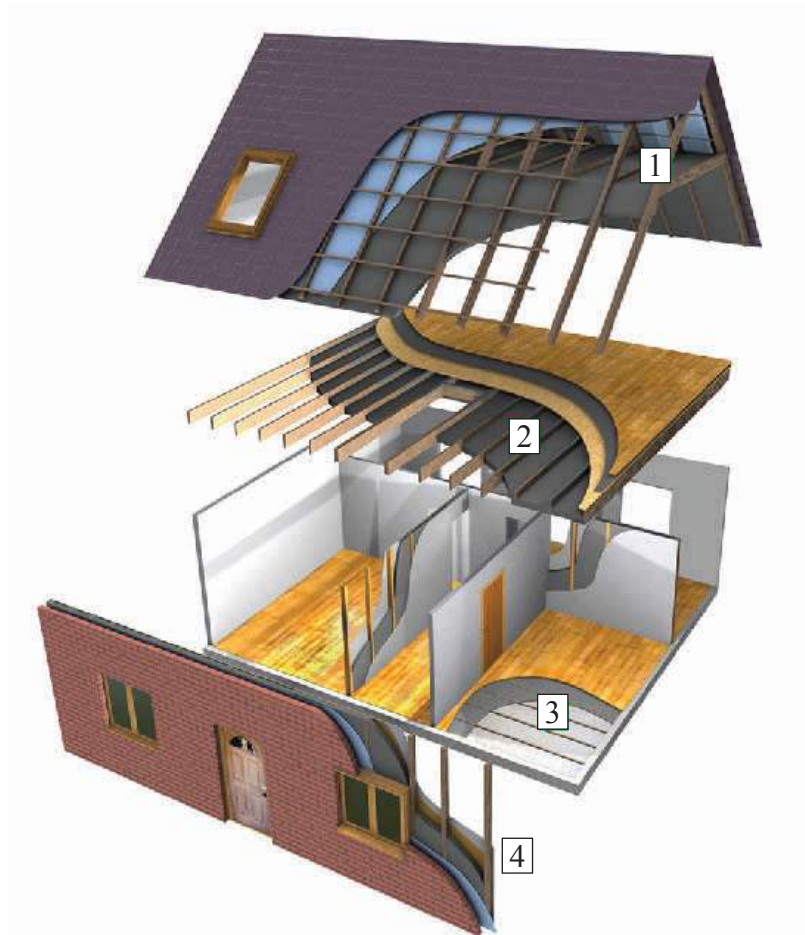
40EP23

Turn over

Option D — Textiles

- 22. Wool can be used as an insulating material to enhance the energy efficiency of buildings as shown in **Figure D1**.

Figure D1: Natural wool insulation



- 1: Attic/Loft Ceiling Level
- 2: Between Floors
- 3: Ground Floor
- 4: Within Walls

[Source: <http://uk.sheepwoolinsulation.com>]

(a) Define *fibres*.

[1]

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(Option D continues on the following page)



40EP24

(Option D, question 22 continued)

- (b) Outline **one** reason why wool needs to be treated before being used as an insulating material in the walls of a building. [2]

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- (c) Explain **one** reason why wool is an appropriate insulating material for the walls of a building. [3]

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- 23. (a) State **one** advantage of an intelligent fabric, such as Elektex™. [1]

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- (b) Describe how fabric such as Elektex™ would contribute to the improved performance of an item like a fabric keyboard. [2]

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(Option D continues on the following page)



40EP25

Turn over

(Option D continued)

- 24. In 1928 Speedo® introduced the first non-wool swimsuit – the Racerback which revolutionized competitive swimming. In 2000, it introduced Fastskin® technology which again revolutionized swimwear for elite swimmers. **Figure D2** shows an enlarged image of Speedo® Fastskin® material which is used for the manufacture of swimwear for elite swimmers.

Figure D2: enlarged image of Speedo® Fastskin® material

Please go to: scienceinthenews.org.uk/contents/?article=8

- (a) Outline **one** reason why Speedo® Fastskin® is an example of a biomimetic material. [2]

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- (b) Outline **one** reason why wool is an unsuitable material for swimsuits. [2]

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(Option D continues on the following page)



(Option D continued)

25. Figure D3 shows men’s ties which can be produced from 100% silk or 100% polyester.

Figure D3: Men’s ties



[Source: «Krawaty». Licensed under CC BY-SA 3.0 via Wikimedia Commons—
<http://commons.wikimedia.org/wiki/File:Krawaty.jpg#mediaviewer/File:Krawaty.jpg>]

Compare **two** characteristics of a tie made from silk with the same design as a tie made from polyester.

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Turn over

(Option D continued)

26. (a) Outline **one** limitation of the widespread use of organic cotton in the textile industry. [2]

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(b) Outline **one** reason why organic cotton continues to be a popular raw material for textile products even though there are much cheaper man-made fibres that could be used in its place for many products. [2]

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(c) Outline **one** reason why some developed countries impose import quotas on textile products. [2]

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(Option D continues on the following page)



(Option D continued)

27. (a) Compare smart clothing with wearable computing.

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(b) Discuss the impact of fashion on the market for wearable computing garments.

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(Option D continues on the following page)



40EP29

Turn over

Option E — Human factors design

29. **Table E1** shows data relating to the Control of Noise at Work Regulations which came into force in the UK in 2006.

Table E1: Daily or weekly noise level exposure levels (UK)

Exposure level	Action required by employer
80 db	Employers must carry out an assessment of the risk to employees health
85 db	Employers must provide hearing protection and hearing protection zones
87 db	Employers must not allow continuous employee exposure above this level

[Source:www.hse.gov.uk]

(a) State **one** health issue associated with exposure to excessive noise. [1]

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(b) Outline **one** reason why equipment, such as a road drill, that creates noise in excess of 87 db is allowed to be used. [2]

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(Option E continues on the following page)



Turn over

(Option E, question 29 continued)

- (c) Explain **one** reason why fire alarms are designed to exceed 87 db. [3]

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30. (a) State the name of the rotational force employed when unscrewing the lid of a jar. [1]

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- (b) Outline **one** reason why a jar is manufactured with a tightly-fastened lid even though the manufacturer knows that it will be difficult to open for some consumers. [2]

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(Option E continues on the following page)



(Option E continued)

31. **Figure E1** shows a Kitchencraft butterfly can opener. **Figure E2** shows a can being opened using the can opener.

Figure E1: Kitchencraft butterfly can opener

Figure E2: Opening a can



Removed for copyright reasons

[Source: <http://smithandwebbcookshop.com>]

(a) Outline **one** human factor reason why the flat handle of the can opener has a twist in it. [2]

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(b) Outline **one** human factor reason for including the holes in the rotating head part of the can opener. [2]

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(Option E continues on the following page)



Turn over

(Option E continued)

- 32. Before the development of the QWERTY keyboard in 1873 by Christopher Sholes the keys of mechanical typewriters often jammed if two adjoining keys were struck rapidly in succession. Sholes rearranged the keys so that the most commonly-used letter sequences were spread out which meant typing took longer.

Discuss memory burden and mapping in relation to the use of the QWERTY keyboard.

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(Option E continues on the following page)



40EP34

(Option E continued)

33. (a) Outline **one** benefit of seating which is an example of design for discomfort for the owner of a fast food restaurant. [2]

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- (b) Outline **one** benefit of design for discomfort for the user of a fast food restaurant. [2]

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- (c) Outline **one** moral responsibility for a designer when using the concept of design for discomfort in the design of seating for a fast food restaurant. [2]

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(Option E continues on the following page)



(Option E continued)

34. (a) Explain **one** way in which digital humans can enhance human factors research in the development of ski clothing for competitive skiers. [3]

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- (b) Explain how motion capture technology is used to create a digital human. [3]

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