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DESIGN TECHNOLOGY
STANDARD LEVEL
PAPER 3

Wednesday 4 November 2009 (morning)

1 hour

Candidate session number

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INSTRUCTIONS TO CANDIDATES

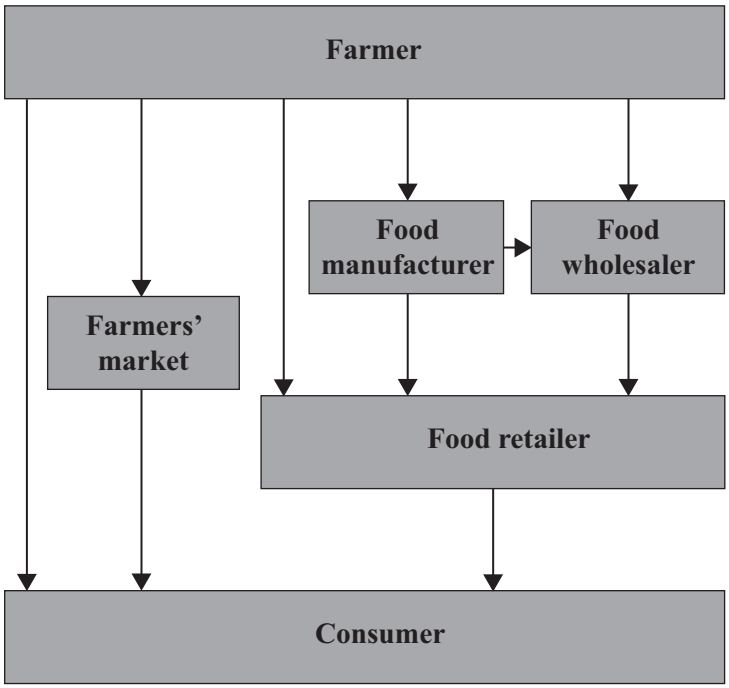
- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all of the questions from one of the Options in the spaces provided. You may continue your answers on answer sheets. Write your session number on each answer sheet, and attach them to this examination paper and your cover sheet using the tag provided.
- At the end of the examination, indicate the letters of the Options answered in the candidate box on your cover sheet and indicate the number of answer sheets used in the appropriate box on your cover sheet.

0122

Option A — Food science and technology

A1. **Figure A1** shows the key stakeholders involved in the food chain between farmer and consumer. Food commodities produced on the farm can be sold by the farmer directly to the consumer either on the farm or via a farmers' market. Alternatively the farmer may sell food to a food manufacturer, a food wholesaler or a food retailer.

Figure A1: Key stakeholders in the food chain between the farmer and the consumer



(a) State **one** advantage for the consumer of purchasing food from the farm. *[1]*

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(b) List **two** stakeholders who are involved in the secondary processing of food commodities. *[2]*

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(This question continues on the following page)

(Question A1 continued)

(c) Explain **one** advantage of on-farm processing of food for the farmer. *[3]*

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A2. (a) Define *obesity.* *[1]*

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(b) Outline **one** psychological issue associated with obesity. *[2]*

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A3. A new technique for preserving milk involves high pressure moderate temperature (HPMT) treatment, *i.e.* high pressure (586 MPa) and moderate temperature (55°C) for five minutes. **Figure A2** compares the flavour and shelf life for pasteurized, sterilized and HPMT-treated milk.

Figure A2: Flavour and shelf life of milk preserved by alternative methods

	Pasteurized milk	**Sterilized (UHT) milk**	**HPMT-treated milk**
Flavour	fresh milk flavour	cooked milk flavour	fresh milk flavour
Shelf life	20 days refrigerated	6 months room temperature	>45 days refrigerated

(a) Outline **one** reason for preserving milk, apart from extending its shelf life. *[2]*

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(b) Identify **one** advantage of HPMT treatment for preserving milk over UHT treatment. *[2]*

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A4. Describe the role of market testing in the development of a food product. *[2]*

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A5. Discuss **two** impacts on consumer health as a result of a change from traditional diets. *[6]*

A6. Explain how aeration, protein coagulation and gelatinization affect the physical and/or chemical properties of bread. *[9]*

Option B — Electronic product design

B1. The circuit shown in **Figure B1** provides an input to a logic system.

Figure B1: Input to a logic system

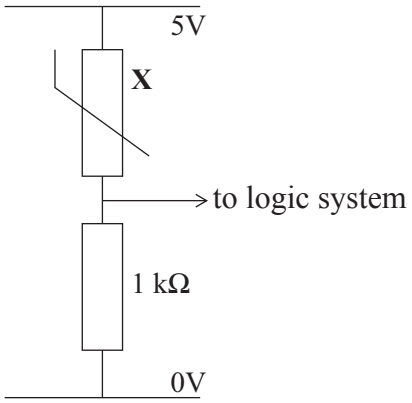
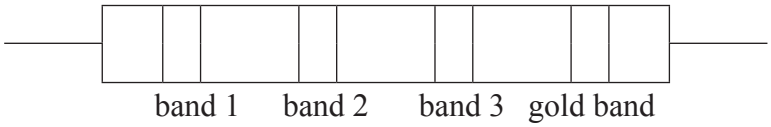


Figure B2: The 1 kΩ resistor



(a) Identify the component labelled **X**. *[1]*

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(b) The first band on the 1 kΩ resistor shown in Figure B2 would be brown. State the colours that bands 2 and 3 would be. *[2]*

Band 2: . . . . . .

Band 3: . . . . . .

(c) Explain how the circuit works to provide an input to a logic system. *[3]*

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B2. (a) Define *programmable interface controller (PIC).* *[1]*

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(b) Outline **one** reason why PICs are particulary suited for portable electronic products. *[2]*

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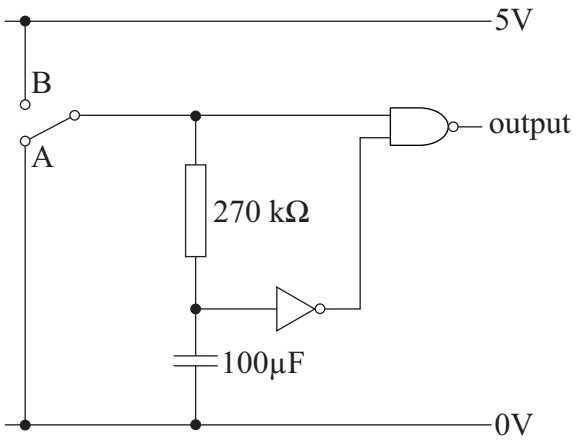
B3. The circuit shown in **Figure B3** is part of an alarm system for a smart home. The user is given a certain time to enter the correct code on a keypad (not shown in the diagram) before the alarm sounds. This circuit is designed to switch from logic 1 to logic 0 when the switch is moved from position A to position B and remains on until the capacitor is fully discharged.

Figure B3: Part of an alarm system for a smart home



(a) Calculate how long it will take for the capacitor to discharge. *[2]*

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(b) Describe the effect of connecting a second 200µF capacitor in parallel with the 100µF capacitor on the duration of the logic 0 output. *[2]*

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B4. List **two** advantages of music being stored in a digital rather than an analogue form. *[2]*

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B5. Explain **two** differences between frequency division multiplexing and time division multiplexing. *[6]*

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B6. Explain **three** different ways in which operational amplifiers working at +15V to –15V can be used (include component values in your explanation and show calculations to justify the values). *[9]*

Application 1:

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Application 2:

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Application 3:

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Option C — CAD / CAM

C1. Haptic technology is an emerging technology that influences the user via the sense of touch. Haptic technology can be used in the training of dentists. A haptic dental training system can reproduce the sensation of inserting a needle while viewing results on the screen – and hearing the "patient" complain if the procedure is not done correctly.

Figure C1: A training device for dental procedures that use haptic technology

[Source: www.bobspaller.com]

Figure C2: Visual display of haptic technology in use

[Source: http://www.digisens.fr/images/ref_bras.jpg]

(a) State **one** advantage to the patient for the use of haptic technology for the training of dentists. *[1]*

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(b) Describe how the haptic technology in Figure C1 works. *[2]*

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(c) Explain **one** disadvantage for a dentist of using haptic technology. *[3]*

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C2. (a) Define *numerical control*. *[1]*

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(b) Outline **one** disadvantage of numerical control. *[2]*

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C3. Fused deposition modelling (FDM) is one method of being able to rapidly produce an item from a 3D CAD image. Modelled parts can include intricate detailing that may be difficult to replicate using other manufacturing methods.

Figure C3: FDM Extrusion

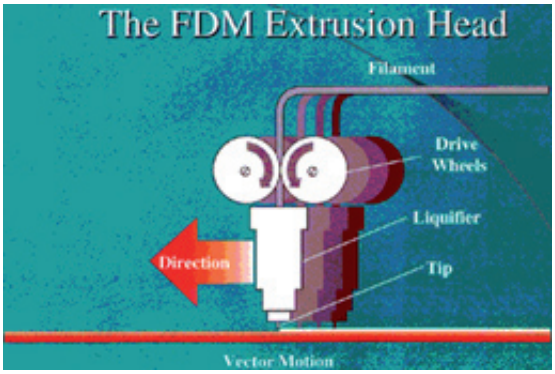
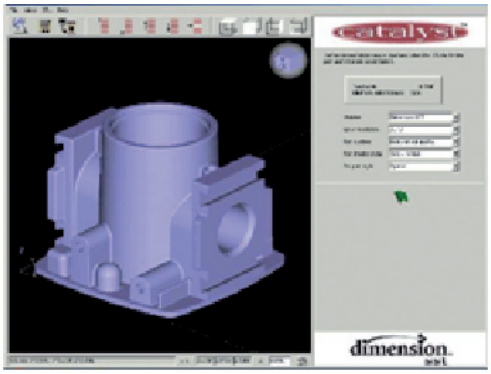


Figure C4: CAD image ready for 3D printing



[Source: Images reproduced with the permission of Stratasys Inc. (www.Stratasys.com)]

(a) Describe how a FDM printer is used to produce the part in Figure C4. *[2]*

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(b) Outline **one** limitation of FDM for volume production. *[2]*

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C4. Outline **one** advantage of being able to adjust the machine tool step variable on a CNC machine. *[2]*

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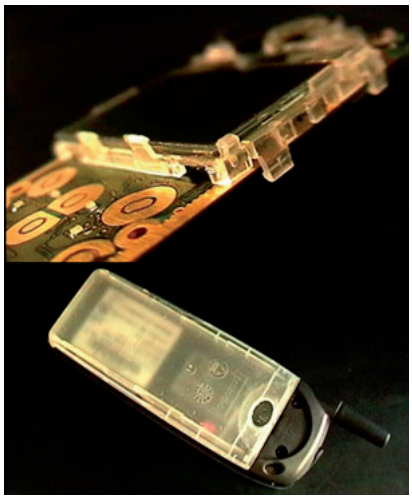
C5. Most cell phones are shredded instead of being taken apart for recycling because of the high cost of disassembly. To overcome this Nokia has developed a new phone that can be disassembled in two seconds using a heat-activated mechanism.

Figure C5: Prototype of Nokia's phone that disassembles in two seconds



[Source: © Nokia]

Discuss **two** benefits of using CAD to design and develop the product housing in Figure C5 for ease of disassembly. *[6]*

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C6. Discuss how raster, spiral and pocket cutting paths alter the quality of a product. *[9]*

Option D — Textiles

D1. **Figure D1** shows a jacket made of a biomimetic fabric which has scales which open and close. The fabric is in the development stage of its product cycle. It works in the same way as a pine cone which opens and closes according to the weather (see **Figure D2**).

Figure D1: Jacket made of biomimetic fabric

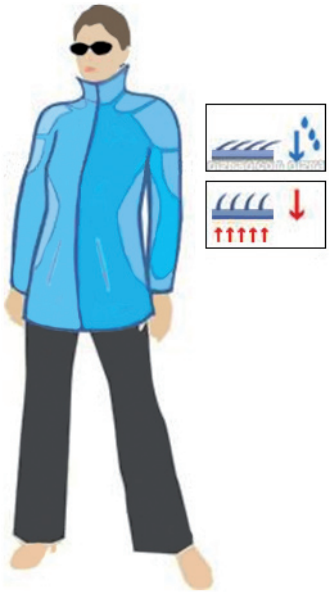

Figure D2: Pine cone

[Source: http://www.gizmag.com/go/3515/gallery/]

(a) Define *biomimetic*. *[1]*

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(b) Outline **one** advantage of the biomimetic fabric to the wearer of the jacket shown in Figure D1. *[2]*

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(c) Discuss **one** issue relating to biomimetic fabrics in the development stage which is addressed through market development. *[3]*

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D2. (a) Define *fabric*. *[1]*

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(b) Outline **one** limitation of knitted fabrics in relation to their dimensional stability. *[2]*

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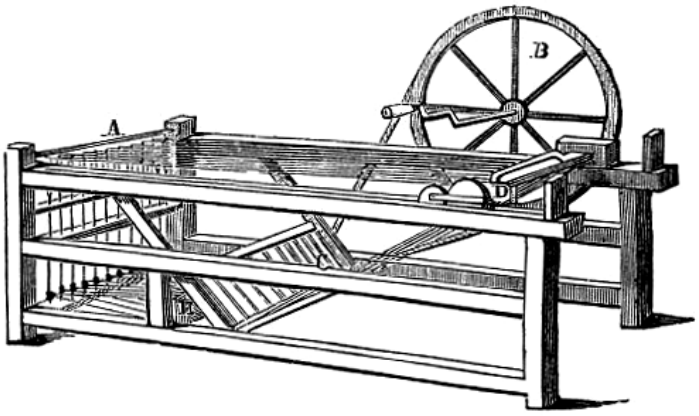
D3. James Hargreaves has been credited with the invention of the Spinning Jenny in about 1764, which is shown in **Figure D3**. This invention, and a series of others, contributed to rapid development of the textile industry.

Figure D3: Spinning Jenny



[Source: http://www.fromoldbooks.org/Antisell-HandbookOfTheUsefulArts/pages/109-SpinningJenny/]

(a) Outline **one** impact of the Spinning Jenny on the textile industry. *[2]*

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(This question continues on the following page)

(Question D3 continued)

(b) Outline **one** way in which mechanization in the textile industry impacted on working conditions. *[2]*

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D4. Describe how molten nylon is converted into yarn. *[2]*

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D5. Discuss **two** considerations relating to the biocompatibility of materials for prostheses. *[6]*

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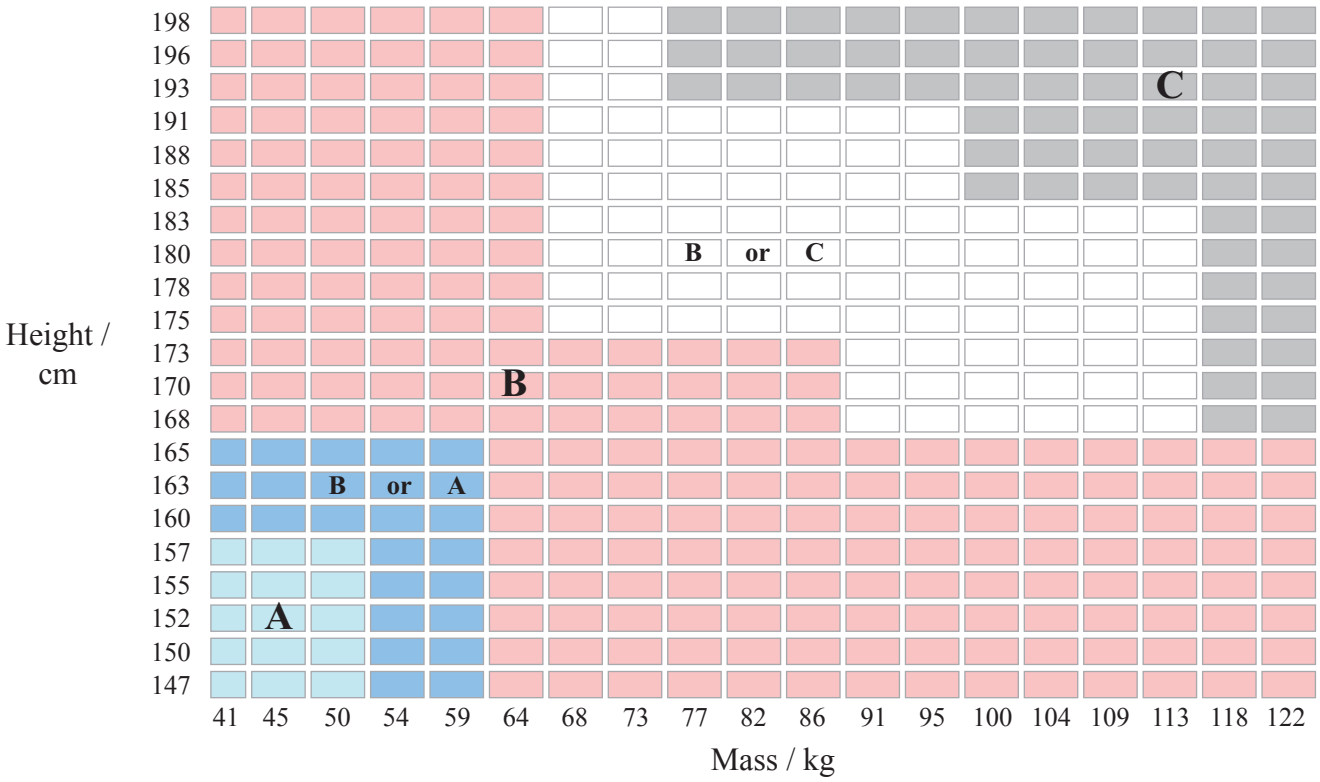
D6. Discuss **three** advantages of using laser image transfer (LIT) when designing textile products. *[9]*

Option E — Human factors design

E1. The Aeron Chair in **Figure E1** was designed in 3 sizes (A, B and C) to fit people from the 1st percentile (female) to the 99th percentile (male). The chart in **Table E1** outlines the weight and height specifications of the people for whom each of the chair sizes was designed.

Figure E1: Aeron Chair

Table E1: Chair design specifications



[Source: Reproduced with the permission of Herman Miller.]

(a) State the height of the shortest person for whom size B chair was designed. *[1]*

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(This question continues on the following page)

(Question E1 continued)

(b) Calculate the height and weight of the range of people for whom the size B chair was designed. *[2]*

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(c) Explain **one** implication of designing a chair for the 1st–99th percentile. *[3]*

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E2. (a) Define *appearance prototype.* *[1]*

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(b) Describe how a functional prototype could enhance the design process of a new type of shopping trolley. *[2]*

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E3. Two different types of phones are pictured below. **Figure E2 (a)** shows a simple phone that sends and receives calls with a large easy to see keypad and four memory buttons. **Figure E2 (b)** shows a more complex phone that can send and receive calls, and includes a video and camera, GPS (Global Positioning System) capability, bluetooth, games and radio and TV reception.

Figure E2 (a): Simple phone

[Source: www.matobmobile.co.uk/index.php?id=about easy use]

Figure E2 (b): More complex phone

[Source: http://www.phonesreview.co.uk/]

(a) Outline **one** issue relating to memory burden for users of the mobile phones E2 (a) and E2 (b). *[2]*

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(b) State a market pull and a technology push design influence that has resulted in the phone design in Figure E2 (b). *[2]*

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E4. Describe how an ordinal scale could be used to collect data about a new phone design. *[2]*

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E5. Compare the primary and secondary anthropometric data a designer would use in a mass produced and a custom made student's desk. *[6]*

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E6. Discuss **three** methods used to identify hazards and evaluate risks in relation to promoting health and safety in the workplace. *[9]*

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