IB DIPLOMA PROGRAMME
PROGRAMME DU DIPLÔME DU BI
PROGRAMA DEL DIPLOMA DEL BI

N03/470/S(3)

DESIGN TECHNOLOGY
STANDARD LEVEL
PAPER 3

Candidate number

Monday 10 November 2003 (morning)

1 hour

INSTRUCTIONS TO CANDIDATES

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

Option A – Raw material to final product

Figure A1 shows a designer bathroom incorporating a range of different materials. The taps and other fittings are made from stainless steel. The shower curtain is made from cotton, which has been treated. The mirror is made from glass.

Figure A1

A1. (a) Outline why cotton needs to be treated for use in the shower curtain. *[2]*

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(b) Explain why treated cotton may have been selected for the shower curtain, despite its shorter product life in comparison with a nylon curtain. *[3]*

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A2. (a) Outline **one** disadvantage of using glass for the mirror in the bathroom. *[2]*

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(b) Outline why large amounts of energy are required to manufacture glass. *[2]*

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A3. Explain how and why iron is processed to make it into stainless steel for use in the towel rail and other fittings in the bathroom. *[6]*

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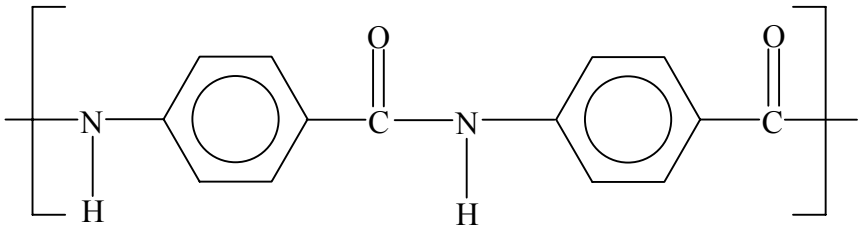
Option B – Products in context

B1. Figure B1 shows the chemical composition of Kevlar® (aramid) which is a very crystalline polymer. Kevlar® is insoluble in most solvents and has an extremely high melting point (550 °C), therefore, it was extremely difficult to find a way to produce Kevlar® fibres.

Figure B1



(a) Describe a crystal. *[2]*

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(b) Outline melting of a crystal in terms of the behaviour of particles and the bonding. *[2]*

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(c) Explain why Kevlar® is suited for manufacturing ropes for certain purposes. *[3]*

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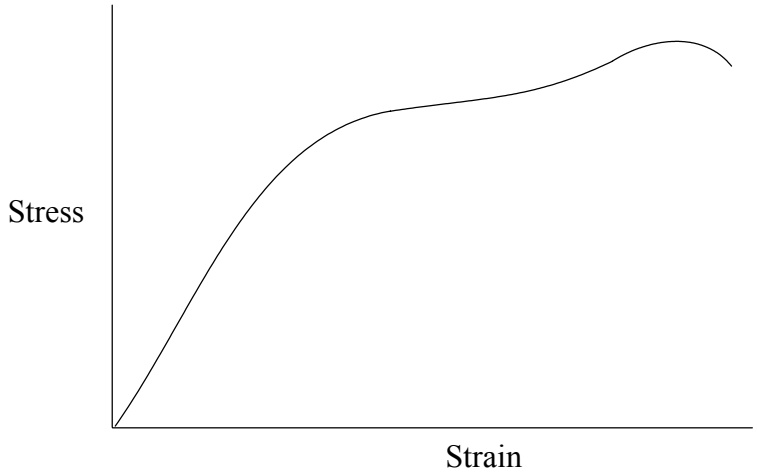
B2. Annotate the following stress/strain graph to show the yield stress and ultimate tensile stress (UTS). *[2]*



B3. Explain how knowledge of the Young's modulus of a material would enable a designer to select a material for a fishing rod. *[6]*

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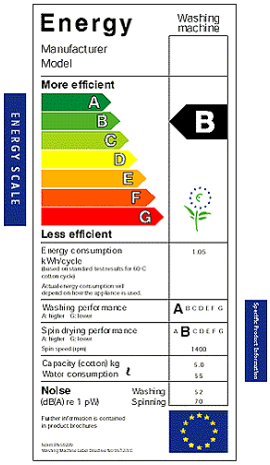
Option C – Appropriate technologies

C1. There are a number of different ecolabelling and energy labelling schemes in use in different countries around the world. Figure C1 shows the European Union Ecolabel based on lifecycle analysis of products and used on products designed with a lower environmental impact. Figure C2 shows a European energy rating label for a washing machine and indicates the amount of energy consumed by the appliance.

Figure C1

Figure C2



(a) Outline how consumer attitudes towards sustainability issues have created a market pull situation. *[2]*

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(b) Outline why the ecolabel is a better assessment of environmental impact than the energy rating label. *[2]*

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(c) Explain **one** way in which ecolabelling schemes contribute towards sustainable development. *[3]*

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C2. List **two** characteristics of an appropriate technology. *[2]*

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C3. Discuss the issues surrounding the need to conserve the resources of the planet and the means to do it. *[6]*

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Option D – Food technology

D1. Figure D1 shows two packets of organic potato crisps. Figure D2 shows the logos for a range of fruit and vegetable crisps from the same manufacturer. The raw fruit or vegetable is sliced, dried and vacuum fried in organic sunflower oil, which is rich in unsaturated fatty acids. Crisps and snack products have a short shelf life due to the development of rancidity.

Figure D1

Figure D2

[Source: http://www.fruitchips.nl]

(a) List **two** organoleptic properties of foods. *[2]*

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(b) Explain how the organoleptic properties of crisps are designed for particular market segments. *[3]*

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D2. Describe oxidative rancidity. *[2]*

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D3. Outline how health consciousness promotes the development of new food products, such as the fruit and vegetable crisps. *[2]*

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D4. Explain how on-farm processing increases the value of food commodities and enhances farm sustainability. *[6]*

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Option E – Computer aided design and manufacturing

E1. Figure E1 shows a computer numerically controlled (CNC) lathe.

Figure E1

(a) Outline the axes that are available on a CNC lathe. *[2]*

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(b) Outline **one** problem of machining wooden parts on a CNC lathe. *[2]*

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(c) Explain how a computer and a CNC lathe can be combined to produce a CAD/CAM system. *[3]*

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E2. Outline how a digital camera might contribute to a CAD system. *[2]*

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E3. Discuss the impact of mass customization on the type and range of products available to the consumer. *[6]*

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Option F – Invention, innovation and design

The first patent for a toaster was submitted in 1905 although it is uncertain if the design ever went into commercial production. The toaster patent was based on the invention of an alloy of nickel and chromium, Nichrome, which was described in its patent as *"very low in electrical conductivity, very infusable, non-oxydizable to a very high degree, tough and sufficiently ductile to permit drawing ... into wire ... for use as an electrical resistance element"*. Figure F1 shows a very early toaster made by General Electric and patented in 1915. Figure F2 shows the first pop-up toaster produced for the domestic market in 1926.

Figure F1

Figure F2

[Source: http://www.toaster.org/1900.html]

F1. (a) Outline **one** safety issue in the design of the toaster shown in Figure F1. *[2]*

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(b) Explain **one** factor which has promoted the reinnovation of the toaster. *[3]*

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F2. Describe the role of design in the continued development of the toaster. *[2]*

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F3. Outline why a pioneering corporate strategy has the potential to make the largest profit. *[2]*

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F4. Discuss how social and economic demands are important in the success of the toaster. *[6]*

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Option G – Health by design

G1. Figure G1 show human bone. Figure G2 shows Pro Osteon, which can be used as an implant material. Pro Osteon is produced by chemically treating coral to produce a material with a pore structure very similar to human bone.

Figure G1 – Human bone

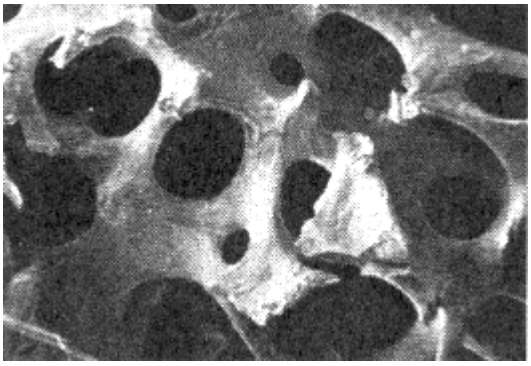
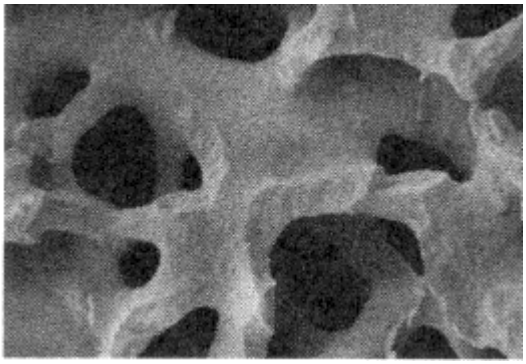


Figure G2 – Pro Osteon



(a) Outline how Pro Osteon would be tested for biocompatability. *[2]*

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(b) Explain how Pro Osteon acts as a temporary framework for bone regrowth. *[3]*

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G2. List **two** materials used in vascular grafts. *[2]*

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G3. Outline how hearing aids are selected to fit in with the lifestyles of users. *[2]*

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G4. Evaluate the potential impact of electric vehicles on public health. *[6]*

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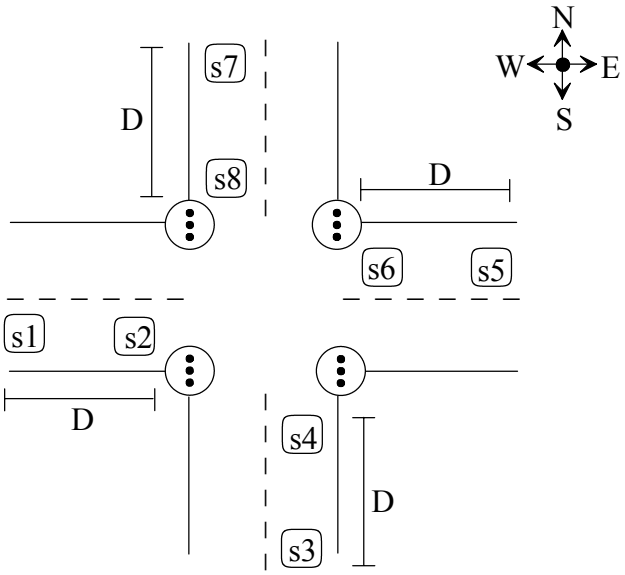
Option H – Electronic products

Figure H1 shows a traffic intersection controlled by traffic lights. A conventional traffic light controller changes the lights using a constant cycle time. Using fuzzy logic and sensors (s1 – s8) it is possible to change the cycle time according to the traffic conditions. The first sensor at each traffic light counts the number of cars coming to the intersection and the second counts the cars passing the traffic lights. Simple IF-THEN rules are used to define the control system, *e.g.*

IF (cycle time is medium) AND (cars behind red is low) AND (cars behind green is medium) THEN change = (probably not).

Figure H1



[Source: http://www.doc.ic.ac.uk/~nd/surprise_96/journal/vol4/sbaa/report.traff.html]

H1. (a) Explain how the fuzzy logic controller works. *[3]*

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(b) Outline **one** benefit for drivers of applying fuzzy logic in this context. *[2]*

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H2. Outline the importance of feedback in the traffic lights system. *[2]*

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H3. Describe a sensor which could be used as one of the sensors s1 – s8 to input information on traffic conditions. *[2]*

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H4. Explain the advantage of a software-controlled programmable system over a hard-wired system for the traffic light system. *[6]*

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