IB DIPLOMA PROGRAMME
PROGRAMME DU DIPLÔME DU BI
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N05/4/DESTE/SP3/ENG/TZ0/XX

88056206

DESIGN TECHNOLOGY
STANDARD LEVEL
PAPER 3

Tuesday 8 November 2005 (morning)

1 hour

Candidate session number

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INSTRUCTIONS TO CANDIDATES

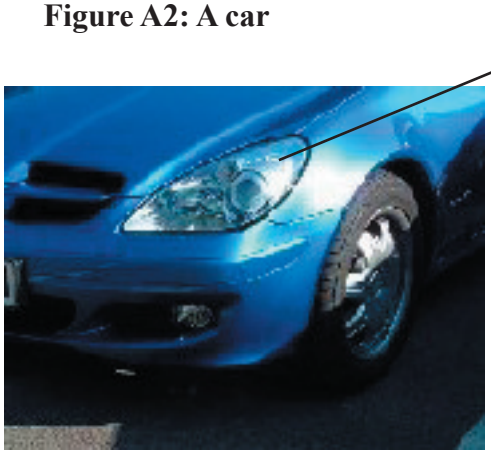
- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all of the questions from two of the Options in the spaces provided. You may continue your answers on answer sheets. Write your session number on each answer sheet, and attach them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

Option A — Raw material to final product

A1. **Figure A1** and **Figure A2** show a washing machine and car respectively. The bodies of both are made from pressed mild steel sheets which are then either welded or bolted together to form the body shape. The windscreen of the car is made from toughened glass. The headlight covers of the car are made from thermoplastic. The car would have carpets made of nylon.

Figure A1: A washing machine

Figure A2: A car



(a) List **two** reasons why mild steel is used for the bodies of the washing machine and the car. *[2]*

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(b) Explain why mild steel must be treated or finished. *[3]*

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A2. (a) Outline **one** reason why toughened glass is used for the windscreen of the car. *[2]*

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(b) Outline **one** reason why thermoplastic is used for the headlight covers of the car. *[2]*

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A3. Explain **two** reasons why nylon would be used for the carpets in the car. *[6]*

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Option B — Microstructures and macrostructures

B1. **Figure B1**, below, shows a photograph of a Suspension Bridge and **Figure B2** shows a sketch of the side elevation of such a bridge.

The road platform of the bridge is made from concrete and pre-stressed steel. The steel reinforcing rods are placed at the bottom of the concrete structure (see **Figure B3**).

Figure B1: A suspension bridge

[Source: www.swe.org/iac/images]

Figure B2: Sketch showing side elevation of a suspension bridge

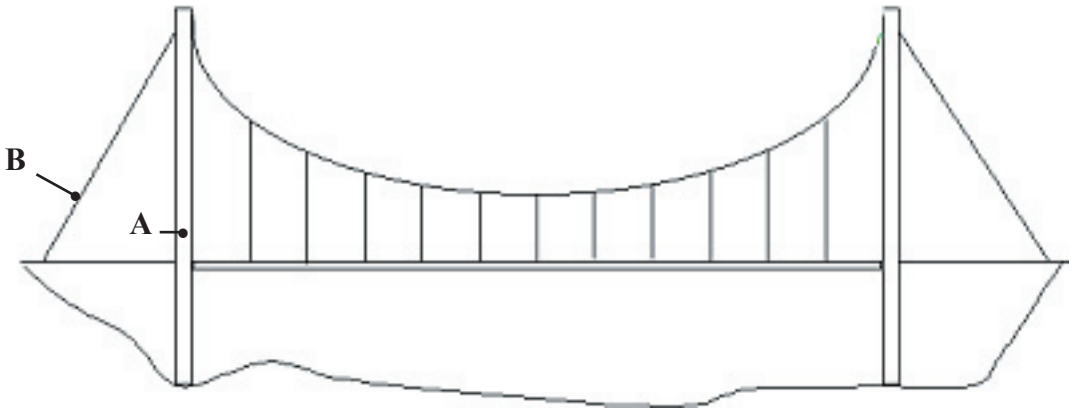

Figure B3: Concrete Structure

(This question continues on the following page)

(Question B1 continued)

(a) State what is meant by the term composite material, as used for the road of the suspension bridge shown in Figure B1. *[1]*

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(b) State the forces shown at points labelled "A" **and** "B" in Figure B2. *[2]*

Forces at **A**: . . . . . .

Forces at **B**: . . . . . .

B2. (a) Explain why the steel reinforcing rods, used in the road platform of the bridge, are placed near to the bottom of the concrete structure as shown in Figure B3. *[3]*

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(b) Define *alloy*. *[1]*

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(c) State **one** mechanical property that can be increased by alloying. *[1]*

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(This option continues on the following page)

(Option B continued)

B3. (a) Define *plastic deformation*. *[1]*

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(b) Explain, how the knowledge of Young's modulus would help a designer in the selection of the material for the suspension cables of the bridge. *[6]*

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Option C — Appropriate technologies

C1. A compact fluorescent lamp (CFL) is a new type of light bulb that fits into a standard incandescent light bulb fitting. Although CFLs are more expensive to buy, they use less energy than traditional incandescent light bulbs. Typically, a CFL rated at 26 Watts gives out as much light as a 75 Watt incandescent light bulb. **Table C1** provides data relating to the typical costs and life of a 75 Watt incandescent light bulb and a 26 Watt CFL.

Table C1: Typical costs and life of a 75 Watt incandescent light bulb and a 26 Watt CFL

	Incandescent bulb	**Compact fluorescent lamp (CFL)**
Initial cost of bulb ($)	0.75	15
Life of bulb (hours)	750	10 000

(a) Calculate how many incandescent bulbs will be used during the life of one CFL. *[2]*

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(b) Deduce how much energy will have been saved during the life of one CFL in comparison to using incandescent bulbs. *[3]*

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(c) Outline **one** way in which CFLs can be considered an appropriate technology. *[2]*

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C2. Identify the difference between a resource and a reserve. *[2]*

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C3. Explain **two** ways in which replacing standard incandescent light bulbs with CFLs is consistent with a policy of sustainable development. *[6]*

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Option D — Food technology

D1. An ice cream making machine (see **Figure D1**) can be used to produce fresh homemade ice cream in different flavours, *e.g.* banana ice cream. The bowl is placed overnight in a deep freezer. The ingredients (cream, milk, eggs, sugar, salt, vanilla extract and bananas) are blended together, added to the machine and aerated by churning the mixture until it is smooth and frozen. When the ice cream is ready, the bowl is detached from the motor unit and the ice cream served.

Figure D1: An ice cream making machine

(a) Outline **one** lifestyle factor that is likely to contribute to the popularity of ice cream making machines as domestic appliances. *[2]*

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(b) Describe what causes browning of bananas during food preparation. *[2]*

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(This question continues on the following page)

(Question D1 continued)

(c) List **two** pieces of information that would be included on the label for a commercial ice cream. *[2]*

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D2. Explain how health awareness might influence the selection of **one** ingredient used in ice cream manufacture. *[3]*

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(This option continues on the following page)

(Option D continued)

D3. Explain **two** strategies that an ice cream manufacturer could use to develop a new commercial ice cream. *[6]*

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Option E — Computer-aided design, manufacture and production

E1. CAD software, *e.g.* ***Pro/DESKTOP,*** can be used to develop designs as well as to produce accurate orthographic drawings. CAD can also be interfaced to CAM to produce a CAD/CAM system. The images below were produced using ***Pro/DESKTOP*** software: **Figure E1** shows the body of the car; **Figure E2** shows the rear wheel; **Figure E3** shows the front wheel; **Figure E4** shows the model car assembled from the body parts (two rear wheels, two front wheels and a body).

Figure E1: Body

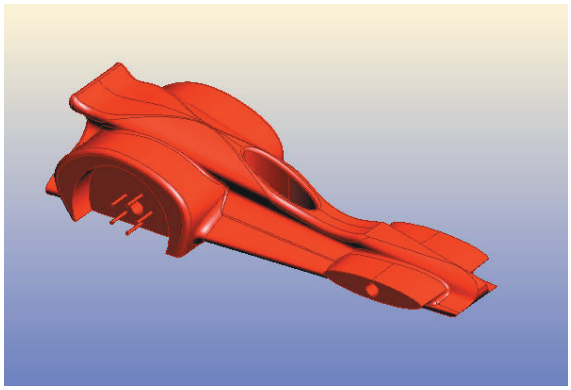


Figure E2: Rear wheel

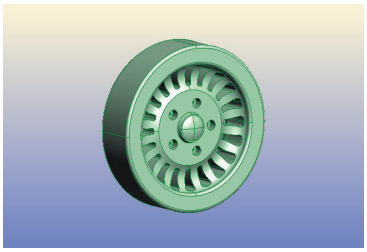


Figure E3: Front wheel

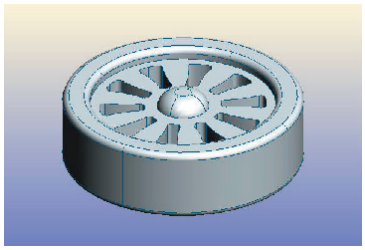
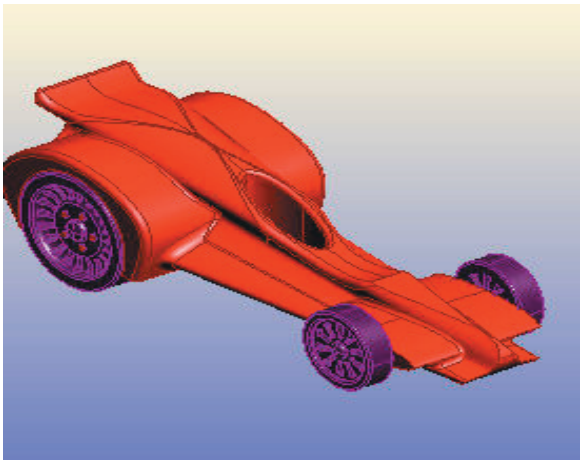


Figure E4: Assembled product



(a) State **one** example of an input device and **one** example of an output device that would be used with the CAD software in the development of the model car. *[2]*

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(b) List **two** benefits of computer modelling of the model car. *[2]*

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(This question continues on the following page)

(Question E1 continued)

(c) Outline **one** advantage for the designer of using a 3-D solid modelling package, such as Pro/DESKTOP. *[2]*

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E2. Explain how mass customisation of the model car could benefit the consumer. *[3]*

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(Option E continued)

E3. Explain **one** advantage and **one** disadvantage of CAD/CAM in the manufacture of the model car. *[6]*

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Option F — Invention, innovation and design

F1. **Figure F1** shows the "Lotus Bicycle" invented by "lone inventor", Mike Burrows and developed further by Lotus Engineering. Lotus has a reputation for manufacturing high quality sports cars so diversifying into bicycle manufacture was a new challenge for the company.

The Lotus bicycle was first shown to the public in 1992 at the Barcelona Olympics. The bicycle frame is manufactured from carbon fibre.

Figure F1: Lotus bicycle

F1. (a) State **one** feature of the design of the Lotus bicycle which has resulted from technology push. *[1]*

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(b) Explain why producing the Lotus bicycle can be considered a pioneering corporate strategy for Lotus Engineering. *[3]*

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F2. (a) Outline **one** reason why many governments promote cycling as part of a pro-active environmental policy. *[2]*

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(b) Explain **one** way in which the design of the bicycle frame does not satisfy the criteria for a pro-active environmental policy. *[3]*

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F3. Discuss **two** possible reasons why the Lotus bicycle has failed to diffuse into the marketplace. *[6]*

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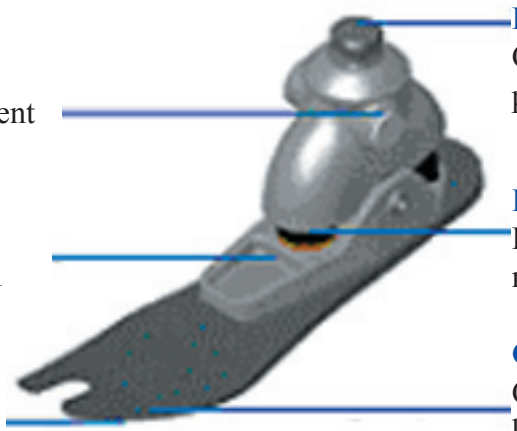
Option G — Health by design

G1. The use of the internet now enables amputees (*i.e.* people who have had one or more limb removed by amputation) to check what products are available and to make appropriate choices to suit their needs. **Figure G1** is an annotated prosthetic foot that is available for amputees. User-centred design is an important element in the design of prostheses.

Figure G1: Prosthetic foot



[Source: adapted from www.osur.com]

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

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(b) Explain why user-centred design is an important element in the design of prostheses. *[3]*

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G2. Allografts have been used to grow new skin on burns victims. Distinguish between an allograft and an autograft. *[2]*

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G3. Explain how the location in which a hearing aid is worn can suit an individual's lifestyle. *[3]*

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G4. Discuss **one** advantage and **one** disadvantage of legislated control standards for motor vehicles. *[6]*

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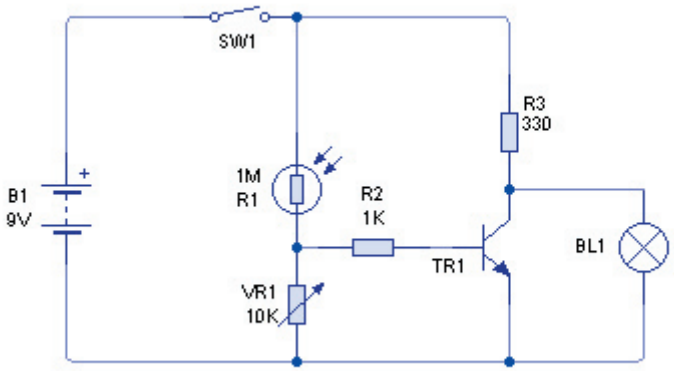
Option H —Electronic products

H1. An automatic wall light for a young person's bedroom is shown in **Figure H1**. The circuit diagram for the electronics which control the light is shown in **Figure H2**.

Figure H1: A young person's bedroom wall-light

Figure H2: The circuit for the bedroom light



(a) State the name of the component labelled as R1 in Figure H2. *[1]*

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(b) Describe the joint function of the components shown as R1 **and** VR1 in Figure H2. *[2]*

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H2. (a) Explain how a systems approach could be applied to designing the circuit shown in Figure H2. *[3]*

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(b) The circuit in Figure H2 shows a low voltage bulb being switched on as the system's output. State how the circuit would be modified so that an LED could be used as the output device instead of the bulb. *[1]*

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(c) State the purpose of the component labelled as TR1 on Figure H2. *[1]*

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(d) State the generic name of a component that would allow feedback from output to input to be provided in a closed-loop electronic system. *[1]*

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(This option continues on the following page)

H3. Discuss how the miniaturization of the components shown in Figure H1 could impact on design decisions made about the product. *[6]*

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