**[C211/SQP162]**

# Advanced Higher Product Design

Specimen Question Paper

Time: 3 hours

NATIONAL QUALIFICATIONS

100 marks are allocated to this paper.

Where appropriate you may use sketches to illustrate your answer.

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**Attempt ALL questions.**

*Marks*

**1.** A manufacturer has produced a hairdryer.

(*a*) Ergonomics is important in areas of analysis and synthesis when designing hand held products.

(i) Describe an evaluative activity which would be carried out during the analysis stage. **2**

(ii) Describe an evaluative activity which would be carried out during the synthesis stage. **2**

When balancing ergonomics against aesthetics there will be certain ergonomic factors that cannot be compromised for the sake of aesthetics.

(*b*) With particular reference to a hairdryer, select and justify **two** ergonomic factors that in your opinion cannot be compromised. **4**

The parent company is not satisfied with the sales performance of the product and wishes to update this model without significantly increasing costs.

(*c*) Specify **two** methods that could be used to achieve this and justify your choices. **4**

**(12)**

*Marks*

**2.** Future legislation may require that public service buses are fully accessible to wheelchair users without the driver needing to leave the cab.

The government has approached design consultancies to develop concepts.

(*a*) Justify the importance of **six** key design factors that should be considered in developing the concepts. **6**

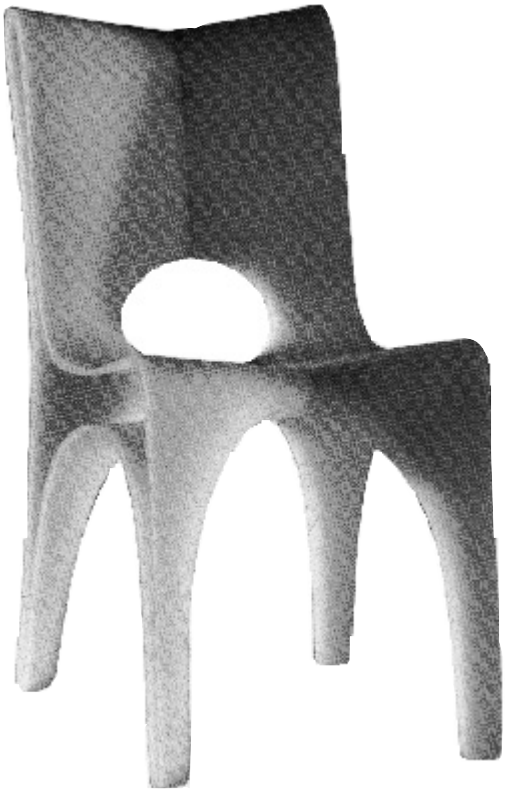
(*b*) Explain how the designer would appraise the suitability of design concepts prior to presenting them to the client. **2**

(*c*) Evaluation is an ongoing activity during the design process.

With reference to the critical stages in generating concepts, describe how evaluation contributes to design development. **2**

**(10)**

**3.** *Marks*



In order to ensure viability in a highly competitive field, the "Chasm" chair (designed by *One Foot Taller*) was targeted at the cafe market and manufactured in a limited number of 500.

As a result of this, it was decided to use a rotational moulding process.

(*a*) State **five** clear advantages or disadvantages the manufacturer will derive from using this process. **5**

A designer is trying to decide between ABS and Polythene as the chosen material to manufacture a product.

(*b*) Summarise the issues the designer would have to consider in arriving at the choice. **2**

(*c*) A manufacturer of plastic garden furniture requires to produce 50 000 quality chairs. It was decided to use an injection moulding process.

(i) State **five** clear advantages or disadvantages the manufacturer will derive from using this process. **5**

Problems that arise during the injection moulding process include sprue marks, sink marks and split lines.

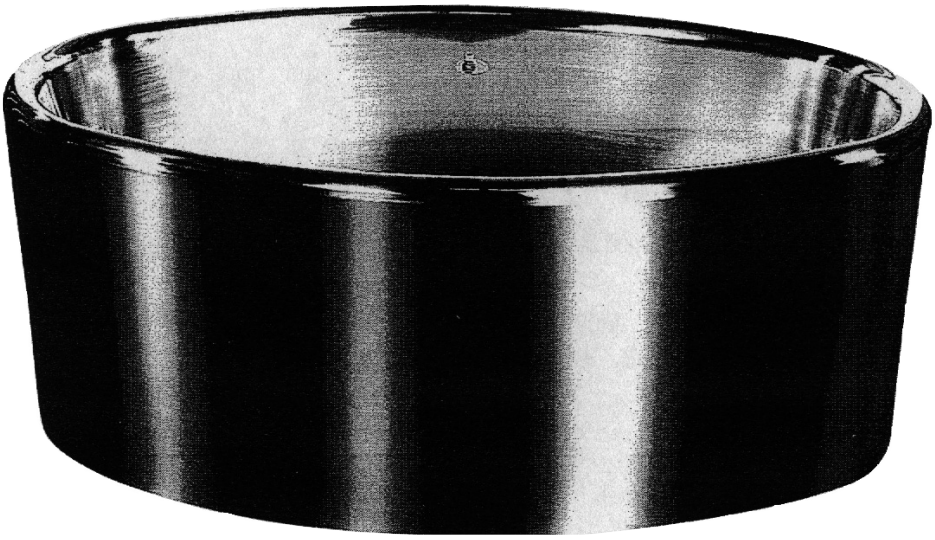
(ii) Describe **two** measures a designer could use to counter these problems.

Appropriate graphics should be used to illustrate your answer. **2**

**(14)**

*Marks*

**4.** The "Ursula" bath, designed by Jon Barnes and Nicky Regan of *Submarine* and manufactured by *Associated Metals Ltd*, looks at the design of a domestic object with the innovative use of an alternative material—stainless steel.



Most modern baths are made in vacuum formed acrylic. The designers, in this case, have opted to manufacture the baths in stainless steel.

(*a*) Analyse the choice of stainless steel as an appropriate material for this product, specifying reasons for its selection and the difficulties which would need to be overcome to achieve this. **6**

The manufacture of the bath required a combination of skills from laser cutting of the stainless steel to the hand welding and hand polishing finish; in the designer's words "*hand built by craftsmen*".

(*b*) Compare the hand skills and high tech processes and their impact on the product from the point of view of:

(i) market niche;

(ii) aesthetics;

(iii) durability. **6**

(*c*) Specify **three** strategies the marketing team could use to assess the sales potential of the bath. **3**

(*d*) A manufacturer wishes to reproduce the bath for a wider market without significantly changing the design.

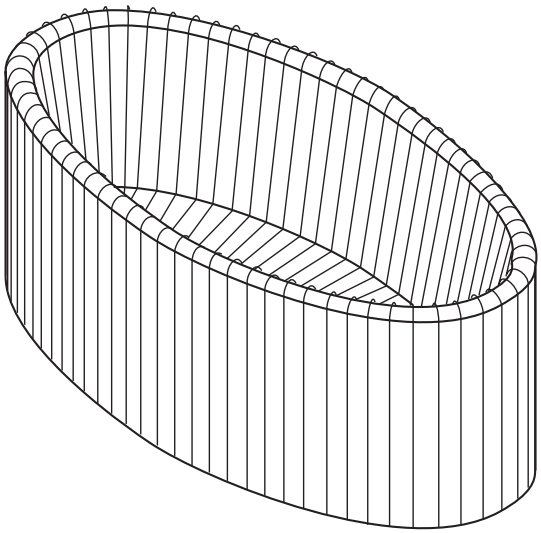
(i) Specify **five** aspects of the bath that could be changed. **5**

(ii) For each aspect identified above, explain how this could affect the impact of the bath on the potential market. **5**

*Marks*

**4. (continued)**

(*e*) The diagram below shows a wire frame image of the bath.



(i) Specify **two** instances where a wire frame image could be useful to the designer. **2**

(ii) There is now greater use of computer design and rapid prototyping by designers to produce models.

(1) Explain what is meant by rapid prototyping. **2**

(2) State **three** benefits of rapid prototyping techniques. **3**

(iii) Give **two** examples of how modern technology has helped improve the quality of the end product. **2**

**(34)**

*Marks*

**5.** From your knowledge of case studies covered in the course, or your own design experience of design projects carried out by professional designers:

(*a*) (i) select a creative thinking technique that could be employed and explain why it is appropriate; **2**

(ii) describe how this technique was carried out and how it would be followed up by the designer. **4**

(*b*) Describe **four** activities that were to be carried out by the designer in synthesising the design to a solution. **8**

Upon presenting the design proposal, concerns were raised by the following:

- Managing Director – feels it has associated ideas with another product
- Production Engineer – retooling costs
- Market Research – limited marketing possibilities
- Health and Safety – product performance

(*c*) Describe how the designer could acknowledge and then address **each** of these concerns. **16**

**(30)**

[*END OF QUESTION PAPER*]

**[C211/SQP162]**

# Advanced Higher Product Design

## Specimen Marking Instructions

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| **Q1 (a)(i)** | Description of an evaluative activity during analysis<br>eg:<br>Research into and tests with a variety of materials/shapes/models/part models:<br>• Ergonomic properties of materials.<br>• Angle of handle.<br>• Grip, texture of handle.<br>• Heat requirements.<br>• Use of video to record movement/holding.<br>• Position of buttons, etc.<br>• Width of handle.<br>• Weight of object.<br>• Shape/form (psychological influence). | Two marks for an appropriate description.<br><br>**[2]** |
| **Q1 (a)(ii)** | Description of an evaluative activity during synthesis<br>eg:<br>User trip of prototype with different client groups to show:<br>• Ease of use/control.<br>• Use of attachments.<br>Possible evaluation of video evidence or through a questionnaire of different groups. | Two marks for an appropriate description.<br><br>**[2]** |
| **Q1 (b)** | Select any **two** factors that cannot be compromised and justify<br>eg:<br>• The length of the handle—designed to the 95 percentile.<br>• Angle of handle to allow access to back of head etc.<br>• Handle cannot be made wider in order to contain specific components. | Two marks for selecting two factors<br>& one mark for justifying each.<br><br>**[4]** |
| **Q1 (c)** | Suggest and justify **two** methods<br>eg:<br>• New product logos.<br>• New colour range.<br>• New packaging.<br>• Re-advertising etc. | One mark for each method and one mark for justifying each.<br>**[4]** |
| | | **Total 12** |

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| **Q2 (a)** | Justify the importance of **six** factors<br>Some examples of factors are:<br>• Must support wheelchair plus adult (sizes & weights considered).<br>• Wheelchair must be secure.<br>• Wheelchair must be prevented from slipping.<br>• Mechanism must be operated by driver.<br>• Mechanism must be able to cope with uneven surfaces.<br>• Capable of being manoeuvred up and down kerbs.<br>• Must be made from water-resistant material.<br>• Must be made from a non-corroding material.<br>• Weight of mechanism to be kept as low as possible to prevent problems with stability/imbalance of bus.<br>• Must be able to be attached to existing buses.<br>• Must satisfy current health and safety requirements.<br>• Mechanism must move at a steady rate with controlled, safe speed.<br>• Mechanism must be relatively quiet in operation.<br>• Audible and visual warnings when in operation etc. | One mark for each appropriate factor justified.<br><br>**[6]** |
| **Q2 (b)** | • Model and test—test rigs, prototypes, models, etc and evaluate using the specification.<br>• User trip—opinions of user group (driver and wheelchair user).<br>• Opinions of client group—assessment against specification and viewing mechanism in operational tests. | Two marks for a suitable explanation considering two of these methods.<br><br>**[2]** |
| **Q2 (c)** | It allows each aspect of the design to be considered carefully and an assessment made of how closely the particular design objective has been met.<br>Reference to:<br>• Evaluation initial ideas.<br>• Synthesis of ideas.<br>• Evaluation of prototypes. | One mark for reference to each critical stage.<br><br>**[2]** |
| | | **Total 10** |

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| **Q3 (a)** | **Advantages**<br>• Low tooling costs.<br>• Good for thick walled designed products.<br>• Little internal stress.<br>• Can use lower quality polymer.<br>• Material recyclable.<br>• Easy and cheap to modify tool.<br>• No core is necessary.<br>• No finishing processes required.<br>**Disadvantages**<br>• High shrinkage.<br>• Flexibility of shape.<br>• Usually used for large objects.<br>• Limitations to complex shape.<br>• Only suited to low manufacture numbers. | One mark for each appropriate advantage or disadvantage stated.<br><br>**[5]** |
| **Q3 (b)** | Examples of issues:<br>• Cost.<br>• Market niche.<br>• Environment—where it will be used.<br>• Texture and surface finish quality.<br>• Obsolescence.<br>• Environmental issues. | One mark for each summary.<br><br>**[2]** |
| **Q3 (c)(i)** | **Advantages**<br>• Detail.<br>• Fine tolerances.<br>• Vary wall thickness.<br>• Wide range of materials.<br>• Cheaper to produce in large numbers.<br>• Consistent quality.<br>• Flexibility and complexity of design.<br>• Choice of colours, textures, etc.<br>• Quality of finish.<br>**Disadvantages**<br>• High tooling costs.<br>• Lengthy setup times.<br>• Process. | One mark for each appropriate advantage or disadvantage.<br><br>**[5]** |
| **Q3 (c)(ii)** | Two descriptions of possible measures used to counter the problems.<br>eg<br>• Use of logos.<br>• Surface texture.<br>• Extra webs, ribs.<br>• False split lines.<br>• Mould design.<br>• Quality of material.<br>• Accuracy of tooling. | One mark for each description.<br><br>**[2]** |
| | | **Total 14** |

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| **Q4 (a)** | Create a new market niche, different from what was already on the market.<br><br>**Reasons for stainless steel**<br>Tough, hard, resistant to wear, attractive, resistant to corrosion, hygienic, contemporary material<br><br>**Difficulties to overcome**<br>Malleability can be affected, difficult to cut or file, prone to tearing when stretched, cold, expensive, labour intensive, possibly easily dated, very heavy | Analyse the choice of stainless steel raising six reasons for or against its choice.<br><br>**[6]** |
| **Q4 (b) (i), (ii), (iii)** | The candidate should contrast and compare the more traditional skills as well as new technologies employed in the answer.<br><br>The comments should consider:<br>• Quality of finish.<br>• Labour costs.<br>• Manufacturing processes being driven by the properties of the material.<br>• Shape/form of the product.<br>• Number being produced.<br>• Facilities/equipment/tools required. | Two marks should be given to each of the 3 areas.<br><br>**[6]** |
| **Q4 (c)** | • The current market for the product.<br>• Feasibility study results.<br>• Expected cost of product.<br>• Target group.<br>• Delivery times.<br>• Background information of product.<br>• Information from exhibitions, competitions. | One mark for each piece of information clearly stated.<br><br>**[3]** |
| **Q4 (d)(i)** | • Alternative materials.<br>• More efficient manufacturing processes.<br>• Simpler shapes/forms.<br>• Introduce standard parts.<br>• Reduce weight of bath.<br>• Common water source/position of taps.<br>• Less model variety.<br>• Reduction in quality of finish/alternative finishes.<br>• Standard sizes/reduced sizes. | One mark for each appropriate area specifically commented on.<br><br>**[5]** |
| **Q4 (d)(ii)** | For each of the aspects identified above, explain its impact.<br>eg<br>• Using alternative materials could reduce the cost therefore allowing the bath to be sold to a wider market. | One mark for each appropriate explanation.<br><br>**[5]** |

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| **Q4 (e)(i)** | • Designers could use the wire frame to produce quality graphic representations of the final object.<br>• Wire frame could be used in conjunction with rapid prototyping process.<br>• Sizes could be altered quickly to give a view of developed solution. | One mark for each appropriate description on the use of the graphic.<br><br>**[2]** |
| **Q4 (e)(ii)(1)** | • Physical models generated directly from CAD systems.<br>• Stereo lithography uses a liquid polymer which is set by the intersection of two lasers and is probably the most common type.<br>• Stacking of paper cross-sections is another method. | Two marks for a clear explanation.<br><br>**[2]** |
| **Q4 (e)(ii)(2)** | • Make changes quickly and easily to CAD image.<br>• Highly accurate model/working prototype.<br>• Eliminate/develop design on computer, saving time.<br>• Working prototype.<br>• Produce tooling for castings.<br>• Highlight problems with the form.<br>• Physical representation of product to touch.<br>• Judge aesthetic/ergonomic/etc value.<br>• Will the client like it (does it have the "X factor"?). | One mark for each appropriate benefit.<br><br>**[3]** |
| **Q4 (e)(iii)** | • Metal cut to size and shape accurately using lasers.<br>• Industrial normalising/tempering to reduce hardening.<br>• Use of CAD/CAM to ensure that products are manufactured accurately or can be adjusted to size quickly. | One mark for each appropriate example given.<br><br>**[2]** |
| | | **Total 34** |

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| **Q5 (a)(i)** | • Brainstorming.<br>• Morphological analysis.<br>• Analogies.<br>• Lateral thinking.<br>• Modelling etc.<br><br>Candidates should give an explanation appropriate to the selected technique stating why it is appropriate.<br><br>Selecting presentation techniques such as mind maps/spider diagrams is not acceptable. | One mark for appropriate method.<br><br>One mark for why it is appropriate.<br><br>**[2]** |
| **Q5 (a)(ii)** | • Explanation of how the chosen method was carried out and followed up. | Two marks for explaining how it was carried out.<br><br>Two marks for explaining how it was followed up.<br><br>**[4]** |
| **Q5 (b)** | Description of four of the following activities:<br>eg<br>• 3D modelling—computer or physical.<br>• Model testing.<br>• User trips.<br>• Survey of reaction to product.<br>• Evaluation to specification.<br>• Video of product being used.<br>• Questionnaires etc.<br><br>During this the designer would probably explore:<br>• Alternative manufacturing processes.<br>• Alternative materials.<br>• Mechanical and electrical systems.<br>• Aesthetic factors.<br>• Ergonomic considerations.<br>• Health and safety compliance. | Two marks for the description of each activity<br><br>**[8]** |

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| **Q5 (c)** | **Managing Director**<br>Concerns:<br>Associates the product with an existing product which might affect and cause customer confusion.<br>Public perception of quality and possible infringement of copyright.<br><br>Solutions:<br>Identify areas of concern (colour, shape, form, performance etc).<br>Further research and analysis.<br>Redevelop design in light of comments and findings.<br><br>**Production Engineer**<br>Concerns:<br>Manufacturing costs.<br>Existing production set up.<br>Existing materials.<br>Component parts.<br><br>Solutions:<br>Work with engineer to highlight problem areas.<br>Look at alternative manufacturing processes and materials.<br>Consideration of existing/standard parts.<br>Redesign to take into account findings.<br><br>**Market Research**<br>Concerns:<br>Product will not sell.<br>Product cannot compete in existing market.<br>Existing market saturated.<br>Too similar to existing products etc.<br><br>Solutions:<br>Gimmick.<br>Better value for money/cheaper.<br>Fashionable.<br>Redesign to take account of findings.<br>Repackaging.<br><br>**Health and Safety**<br>Concerns:<br>Does not comply with H & S.<br>Cannot be sold without safety certificate.<br><br>Solutions:<br>Ensure safety and compliance with regulations.<br>Test thoroughly before presenting final proposal.<br>Work closely with H & S office/dept. | Four marks for each scenario.<br><br>Two marks will be given for the explanation of the concern.<br><br>Two marks will be given for how the designer would address the concern.<br><br>**[16]** |
| | | **Total 30** |

**[END OF MARKING INSTRUCTIONS]**