National
Qualifications
SPECIMEN ONLY

S819/77/11 Design and Manufacture

Duration — 2 hours 15 minutes

Total marks — 80

SECTION 1 — 30 marks

Attempt BOTH questions.

SECTION 2 — 50 marks

Attempt ALL questions.

Write your answers clearly in the answer booklet provided. In the answer booklet you must clearly identify the question number you are attempting.

Use **blue** or **black** ink.

Before leaving the examination room you must give your answer booklet to the Invigilator; if you do not, you may lose all the marks for this paper.

S8197711

MARKS

SECTION 1 — 30 marks

Attempt BOTH questions

1. During your course you will have analysed the manufacture of a commercial product(s).

Identify a commercial product(s) you have analysed.

(a) Outline **five** pieces of information gained from your analysis which led to your conclusions about the **performance** of the product(s). **5**

(b) Discuss the influence materials had on the performance of the product(s). You may refer to the following

- function
- durability
- maintenance
- aesthetics
- safety. **6**

(c) Describe the impact of the product(s) on the environment. **5**

2. During your course you will have researched the evolution of a commercial product(s).

Identify a commercial product(s) you have researched.

(a) Describe how the evolution of the product has been influenced by

(i) materials, manufacture and technology **6**

(ii) changes in society. **4**

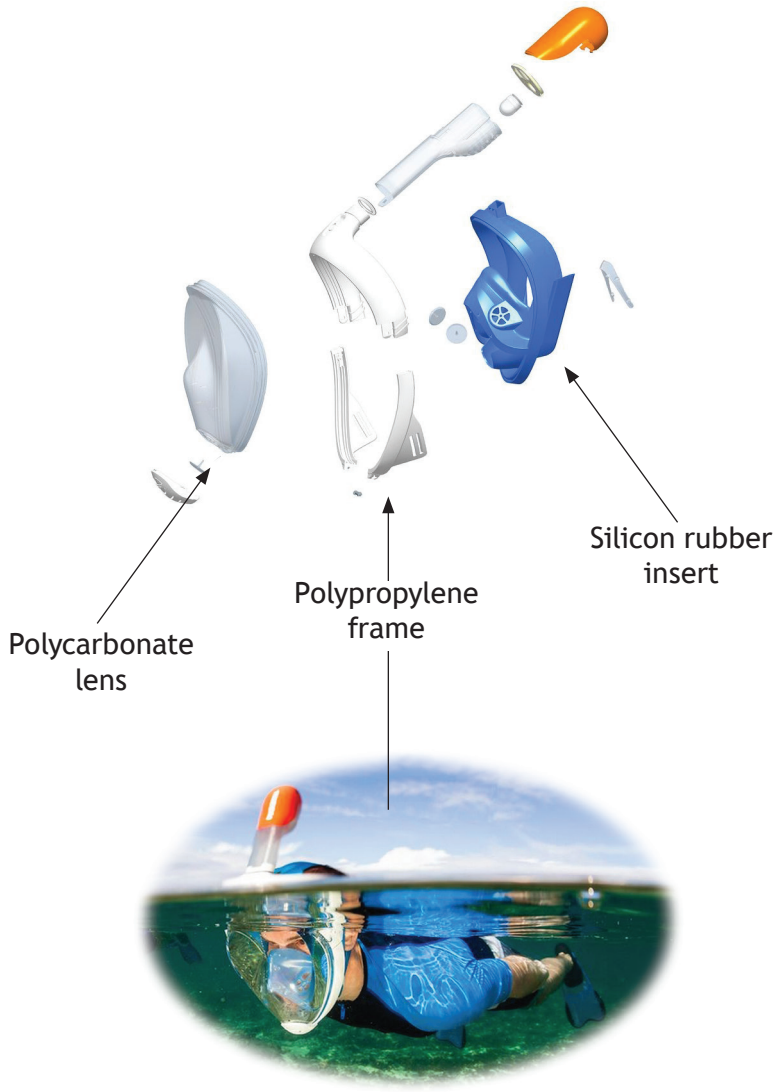
Products will continue to evolve.

(b) Describe possible future developments in a product(s) you have studied **and** explain why they are likely to happen. **4**

SECTION 2 — 50 marks

Attempt ALL questions

3. The Easybreath mask manufactured by Tribord is shown below. It provides a comfortable, hygienic, and natural breathing experience when snorkelling.



The Easybreath mask is manufactured using a combination of plastics.

(a) Explain why the materials named above are suitable for the different components of the Easybreath mask. **3**

Plastic additives were added to the polycarbonate, polypropylene and silicon rubber during the manufacture of the mask.

(b) Explain why additives are added to plastics when manufacturing products such as the Easybreath mask. **3**

[Turn over

MARKS

3. (continued)

Two-shot injection moulding could have been used to manufacture the mask.

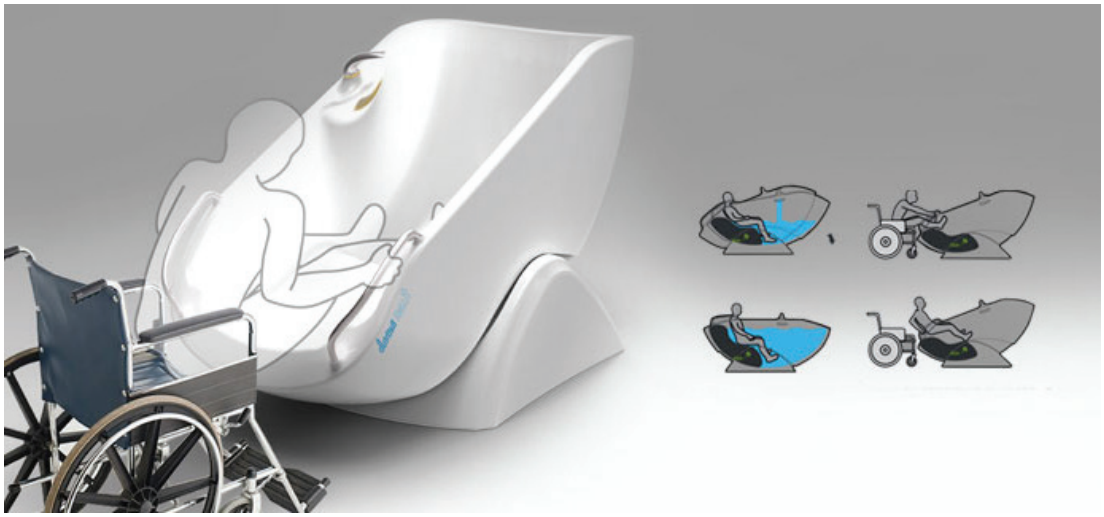
(c) Describe the benefits and drawbacks of using two-shot injection moulding to manufacture the mask. **3**

Injection moulded parts can have undercuts, complex features and be difficult to remove from their moulds.

(d) Describe how these difficulties can be overcome. You may use sketches to illustrate your answer. **4**

MARKS

4. The Flume bath 'see-saw' tub, designed by Kim Jung Su, Yoon Ji Soo and Kim Dong Hwan, was designed for people with restricted movement.



Designers often design products for situations and user groups with which they are unfamiliar.

(a) Describe how the designers could have ensured the Flume bath was comfortable and easy to use for its intended user group. **4**

'Just-in-time' production could have been used to manufacture products such as the Flume bath.

(b) Describe the benefits and drawbacks of using 'Just-in-time' production. **4**

Manufacturers of products such as the Flume bath can seek to obtain a Kitemark from the British Standards Institute (BSI) for their products.

(c) Describe the benefits and drawbacks to a manufacturer of obtaining a Kitemark from the BSI. **4**

5. Adopting a radical approach to redesigning products can be a high-risk strategy for designers and manufacturers.

(a) Describe the challenges faced by designers when developing a radical design concept, compared to making incremental changes to an existing product. **4**

(b) Outline the potential risks of launching a radical product **and** explain how they may be overcome. **4**

Designers and manfacturers can use patents to protect their intellectual property created when developing radical design concepts.

(c) Explain why a patent is suitable for protecting radical design concepts. **3**

MARKS

6. The RoboWorm was designed to access difficult to reach spaces during search and rescue operations.

Computer Aided Design (CAD) was used during the development on the Roboworm.

(a) Describe the benefits CAD provides when developing products such as the RoboWorm. **3**

The RoboWorm was manufactured using 3D printers instead of traditional processes and assembly methods. This reduced the manufacturing cost from £5000 to £2000.

(b) Explain why 3D printing the RoboWorm resulted in a reduction in manufacturing costs. **4**

Manufacturers of products such as the RoboWorm must ensure their products are manufactured and assembled to the highest standards.

(c) Outline the steps a manufacturer can take to ensure their products are manufactured and assembled to the highest standard. **4**

Manufacturing faults can lead to product recalls.

(d) Outline the consequences of a product recall for a company. **3**

[END OF SPECIMEN QUESTION PAPER]

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Marking Instructions

These marking instructions have been provided to show how SQA would mark this specimen question paper.

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General marking principles for Advanced Higher Design and Manufacture

Always apply these general principles. Use them in conjunction with the detailed marking instructions, which identify the key features required in candidates' responses.

(a) Always use positive marking. This means candidates accumulate marks for the demonstration of relevant skills, knowledge and understanding; marks are not deducted for errors or omissions.

(b) If a candidate response does not seem to be covered by either the principles or detailed marking instructions, and you are uncertain how to assess it, you must seek guidance from your team leader.

(c) Where a question asks a candidate to **describe**, they must provide a statement or structure of characteristics and/or features. This should be more than an outline or a list. It may refer to, for example, a concept, process, experiment, situation, or facts, in the context of and appropriate to the question.

(d) Where a question asks candidates to **explain**, they must relate cause and effect and/or make relationships between things clear, in the context of the question or a specific area within the question.

Marking instructions for each question

Section 1

Question			Expected response	Max mark	Additional guidance
1.	(a)		Candidates are expected to outline **five** pieces of information gained from their analysis which led to conclusions about the **performance** of the product(s). Typical answers are likely to include • reference to function, durability, maintenance, aesthetics, safety, ergonomics • information gained from comparisons, tests, user trips and user trials.	**5**	Award marks using the best fit characteristics shown below. **1 mark** for each outline provided. Do not award a mark for simply stating, for example, the kettle boiled water quickly. Response must be appropriate to Advanced Higher level and outline information gained from their analysis of a commercial product(s). *The partial response below exemplifies the detail looked for at this level. It was taken from a full answer that was awarded **5 marks**.* The product I evaluated was the Russell Hobbs Windsor kettle. The kettle functions well as it heats 1 litre of water in 1 minute and 40 seconds which is quicker than most products on the market which take between 2–4 minutes.

Question			Expected response	Max mark	Additional guidance
	(b)		Candidates are expected to discuss the influence materials had on the performance of product(s) they analysed during the course. Although there is an underlying body of design knowledge required to answer it, there is a wide range of possible answers. The question is therefore marked holistically. The features which are looked for are knowledge of the subject matter, ability to comprehend the question and to construct an answer which uses clear examples to support the points made. Typical answers are likely to include • reference to specific materials • reference to parts or aspects of the product • reference to the following — function — durability — maintenance — aesthetics — safety.	**6**	Award marks using the best fit characteristics shown below. Do not award a mark for simply stating, for example, that metal alloy made it strong and lightweight. Candidates are expected to discuss the influence materials had on the performance of product(s) they analysed during the course. Response must be appropriate to Advanced Higher level and provide a discussion with appropriate detail referencing information gained from analysing the materials used to manufacture commercial product(s). *The partial response below exemplifies the detail looked for at this level. It was taken from a full answer that was awarded marks in the top band.* The Russell Hobbs Windsor kettle was manufactured from a range of materials which influenced its performance. The kettle's body was made from stainless steel which allowed the body to be very thin. This ensured most of the energy from the element was used to heat the water and not the kettle's body. However as stainless steel provides little insulation the water cooled quickly after boiling, resulting in frequent re-boiling.

An answer which falls into these categories may do so for a number of reasons. It is likely that		
0–2 marks	**3–4 marks**	**5–6 marks**
Candidate demonstrates a limited knowledge and understanding of the subject matter. • limited reference to a product(s) • generic justification of materials • limited reference to materials • limited reference to performance requirements of the product • limited reference to information gained from analysis.	Candidate demonstrates knowledge of the subject matter and an understanding of the main aspects. • reference to a product(s) • reference to specific materials • reference to main performance requirements of the product • information drawn from analysis.	Candidate demonstrates sound knowledge of the subject matter and a secure understanding of the main aspects. • good reference to a product(s) • detailed reference to specific materials • detailed reference to key performance requirements • information clearly drawn from analysis.

Question			Expected response	Max mark	Additional guidance
	(c)		Candidates are expected to identify a product they analysed and describe its impact on the environment. The features which are looked for are knowledge of the subject matter, ability to comprehend the question and to construct an answer which uses clear examples to support the points made. Typical answers are likely to include • impact of materials • impact of manufacturing processes • impact of assembly methods • impact of production systems • pollution • efficiency • life expectancy • landfill • recycling reuse.	**5**	Award marks using the best fit characteristics shown below. Do not award a mark for simply stating, for example, that manufacturing processes used caused pollution and damage to the environment. Response must be appropriate to Advanced Higher level and provide description with appropriate detail referencing information gained from analysing a product(s) impact on the environment. *The partial response below exemplifies the detail looked for at this level. It was taken from a full answer that was awarded marks in the top band.* The Russell Hobbs kettle is manufactured in high volumes and assembled using integrated fixings and adhesives. This has created an affordable kettle which is disposable, and is likely to end up in landfill rather than being repaired.

An answer which falls into these categories may do so for a number of reasons. It is likely that		
0–2 marks	**3–4 marks**	**5 marks**
Candidate demonstrates a limited knowledge and understanding of the subject matter. • limited reference to a product(s) • limited reference to manufacture and/or use • generic reference to impact on the environment • limited reference to information gained from analysis.	Candidate demonstrates knowledge of the subject matter and an understanding of the main aspects. • reference to product(s) • reference to manufacture and/or use of product(s) • information drawn from analysis • reference to positive and/or negative impact on the environment.	Candidate demonstrates sound knowledge of the subject matter and a secure understanding of the main aspects. • detailed reference to specific product(s) • detailed reference to manufacture and/or use of product(s) • information clearly drawn from analysis • detailed reference to positive and/or negative impact on the environment.

Question			Expected response	Max mark	Additional guidance
2.	(a)	(i)	Candidates are expected to describe how materials, manufacture and technology have influenced the evolution of the product(s) they studied during the course. Although there is an underlying body of design knowledge required to answer it, there is a wide range of possible answers. The question is therefore marked holistically. The features which are looked for are knowledge of the subject matter, ability to comprehend the question and to construct an answer which uses clear examples to support the points made. Typical answers are likely to include • reference to notable turning points • reference to significant changes in materials, manufacture and technology • reference to significant changes to a product(s) — improvements to function — changes to aesthetics — improved ergonomics — increased availability — improved performance — safety — affordability — availability • reference to influential products.	**6**	Award marks using the best fit characteristics shown below. Do not award a mark for simply stating, for example, the use of carbon fibre has made cars lighter and stronger. Response must be appropriate to Advanced Higher level and provide a description with appropriate detail referencing how materials, manufacture and technology have influenced the evolution of a product(s) they have studied. *The partial response below exemplifies the detail looked for at this level. It was taken from a full answer that was awarded marks in the top band.* The evolution of the vacuum cleaner was heavily influenced by developments in technology. The first vacuum cleaners were diesel powered and too large be taken indoors. The availability of electricity in the home in the early1900s allowed smaller mechanical devices to replace the large machines and the manually operated carpet sweeper of the time. These early domestic vacuum cleaners were still large, heavy and difficult to manoeuvre. However the development of a small powerful AC and DC electric motor in 1910 paved the way for the development of a usable plug-in vacuum cleaner. They were used by the majority of companies to reduce the size and weight and improve the efficiency of their vacuum cleaners.

An answer which falls into these categories may do so for a number of reasons. It is likely that		
0–2 marks	**3–4 marks**	**5–6 marks**
Candidate demonstrates a limited knowledge and understanding of the subject matter. • limited reference to turning points • limited reference to changes in materials, manufacture and technology • limited reference to changes to a product(s).	Candidate demonstrates knowledge of the subject matter and an understanding of the main aspects. • reference to turning points • reference to specific changes in materials, manufacture and technology • reference to notable changes to a product(s).	Candidate demonstrates sound knowledge of the subject matter and a secure understanding of the main aspects. • reference to key turning points • detailed reference to specific changes in materials, manufacture and technology • detailed reference to notable changes to a product(s).

Question			Expected response	Max mark	Additional guidance
		(ii)	Candidates are expected to describe how changes in society have influenced the evolution of the product(s) they studied during the course. Although there is an underlying body of design knowledge required to answer it, there is a wide range of possible answers. The question is therefore marked holistically. The features which are looked for are knowledge of the subject matter, ability to comprehend the question and to construct an answer which uses clear examples to support the points made. Typical answers are likely to include reference to social changes such as • youth culture of the 50s • baby boom of the 50s • throwaway society • concern for the environment • aging population • austerity • smaller families. Typical answers are likely to include reference to changes to some of the following during a product(s) evolution • aesthetics • function • performance • safety • economics • ergonomics.	**4**	Award marks using the best fit characteristics shown below. Do not award a mark for simply stating, for example, society's changing attitudes towards the environment has made companies design environmentally friendly products. Response must be appropriate to Advanced Higher level and provide a description with appropriate detail referencing how changes in society have influenced the evolution of a product(s) they have studied. *The partial response below exemplifies the detail looked for at this level. It was taken from a full answer that was awarded marks in the top band.* People are living longer and are more active into their old age. Car manufacturers such as Subaru are developing their cars to ensure they meet the needs of an ageing population. They have increased the size of the gauges and provided easy to read fonts. Gauges are also placed high on the dashboard to help keep a driver's eyes on the road.

An answer which falls into these categories may do so for a number of reasons. It is likely that		
0–1 marks	**2–3 marks**	**4 marks**
Candidate demonstrates a limited knowledge and understanding of the subject matter. • generic changes to influence of society • little reference to social changes • limited and vague reference to evolution of a product(s) • few points are made that address the question.	Candidate demonstrates knowledge of the subject matter and an understanding of the main aspects. • reference to specific social changes • reference to evolution of a product(s).	Candidate demonstrates sound knowledge of the subject matter and a secure understanding of the main aspects. • detailed reference to specific social changes • detailed reference to evolution of a product(s).

Question			Expected response	Max mark	Additional guidance
	(b)		Candidates are expected to describe possible future developments in a product(s) they have studied and explain why they are likely to happen. Although there is an underlying body of design knowledge required to answer it, there is a wide range of possible answers. The question is therefore marked holistically. The features which are looked for are knowledge of the subject matter, ability to comprehend the question and to construct an answer which uses clear examples to support the points made. Typical answers are likely to include future developments such as • functional and aesthetic improvements and changes • improvements to performance, safety, maintenance and durability • improved ergonomics, interaction and accessibility • changes in economics — affordability, accessibility • environmental impact and sustainability. Typical answers are likely to include reasons for future developments such as • 3D scanning/printing • robotics • advances in materials, manufacture and technology • smart materials • artificial intelligence • nanotechnology • communication between products • advances in computing • changes in society • changing attitudes.	**4**	Award marks using the best fit characteristics shown below. Do not award a mark for simply stating, for example, cars will be driverless due to advances in computer technology and the use of GPS. Response must be appropriate to Advanced Higher level and provide a description with appropriate detail referencing the future evolution of a product(s) they have studied. *The partial response below exemplifies the detail looked for at this level. It was taken from a full answer that was awarded marks in the top band.* A Japanese company is developing a new plastic that is hoped will replace steel in car production and provide a car body that is injection moulded from plastic. Developments in high performance plastics will pave the way for the increased use of 3D printing to manufacture cars which will provide more bespoke designed cars in an industry traditionally developed around standardisation and limited choice.

An answer which falls into these categories may do so for a number of reasons. It is likely that		
0–1 marks	**2–3 marks**	**4 marks**
Candidate demonstrates a limited knowledge and understanding of the subject matter. • generic reference to future developments of products • little reference to future developments • limited and vague reference to issues that influence future developments • limited reasoning for future developments • few points are made that address the question.	Candidate demonstrates knowledge of the subject matter and an understanding of the main aspects. • reference to a specific product(s) • reference to future developments • reference to issues that influence future developments • future developments justified.	Candidate demonstrates sound knowledge of the subject matter and a secure understanding of the main aspects. • reference to a specific product(s) • detailed reference to future developments • specific reference to issues that influence future developments • future developments fully justified.

Question			Expected response	Max mark	Additional guidance
3.	(a)		Candidates are expected to explain why the materials named are suitable for the different components of the Easybreath mask. Typical answers are likely to include • improving the comfort to the user • enhancing the seal • durability issues • provides structural strength to the mask • lightweight (strength-to-weight ratios) optical properties • hygiene.	**3**	**Award 1 mark** for explanation of suitability for each material. Do not award a mark for simply stating, for example, polycarbonate is suitable for the lens as it is waterproof and durable. Response must be appropriate to Advanced Higher level and provide an explanation with appropriate detail with reference to the Easybreath mask. *The partial response below exemplifies the detail looked for at this level. It was taken from a full answer that was awarded **3 marks**.* Polycarbonate is waterproof, durable and has excellent optical properties. This makes it suitable for the lens as the mask will be submerged in water for prolonged periods. The mask needs to be wiped frequently, in sandy environments, so needs to be durable to scratches.
	(b)		Candidates are expected to explain why additives are added to plastics when manufacturing products such as the Easybreath mask. Typical answers are likely to include • improving properties of plastics • aiding the manufacture of products • improving the performance of products.	**3**	**Award 1 mark** for each valid point explaining why additives are added to plastics. Do not award a mark for simply stating, for example, additives change the characteristics of plastics. Response must be appropriate to Advanced Higher level and provide an explanation with appropriate detail. *The partial response below exemplifies the detail looked for at this level. It was taken from a full answer that was awarded **3 marks**.* Plastics in their raw state tend to be clear or opaque. If coloured plastic is required such as the white frame or the blue insert of the mask colouring additives are required.

Question			Expected response	Max mark	Additional guidance
	(c)		Candidates are expected to describe the benefits and drawbacks of using two-shot injection moulding to manufacture the mask. Typical answers are likely to include • less moulds required • reduction of parts • reduction in assembly • reduced lead time • no joins (watertight) • cost effective • efficient • can't be disassembled • expensive to recycle.	**3**	Award **1 mark** for each appropriate description. Do not award a mark for simply stating, for example, using two shot injection moulding joins two plastics together in the same mould. Response must be appropriate to Advanced Higher level and provide a description with appropriate detail with reference to the Easybreath mask. *The partial response below exemplifies the detail looked for at this level. It was taken from a full answer that was awarded **3 marks**.* Two-shot injection moulding would create a seamless join between the frame and the insert that would provide a watertight seal that does not require glues or sealant and improve the performance of the mask.

Question			Expected response	Max mark	Additional guidance
	(d)		Candidates are expected to describe how to overcome the difficulties created by undercuts, complex features and the difficulty of removing injection moulded parts from their moulds. Although there is an underlying body of design knowledge required to answer it, there is a wide range of possible answers. The question is therefore marked holistically. The features which are looked for are knowledge of the subject matter, ability to comprehend the question and to construct an answer. Typical answers are likely to include • number of parts to the mould • use of location pins • draft angles • radius and fillets • placement and number of injection points • use and placement of ejector pins • redesign.	**4**	Award marks using the best fit characteristics shown below. Do not award a mark for simply stating, for example, using draft angles and radius corners. Response must be appropriate to Advanced Higher level and provide a description with appropriate detail. *The partial response below exemplifies the detail looked for at this level. It was taken from a full answer that was awarded marks in the top band.* Undercuts create a number of challenges that can be overcome by carefully designing the mould. The mould can be created in a number of parts that fit together accurately by using location pins.

An answer which falls into these categories may do so for a number of reasons. It is likely that		
0–1 marks	**2–3 marks**	**4 marks**
Candidate demonstrates a limited knowledge and understanding of the subject matter. • little reference to undercuts, complex features and the difficulty of removing injection moulded parts from their moulds • limited and vague reference to how difficulties could be overcome • few points are made that address the question.	Candidate demonstrates knowledge of the subject matter and an understanding of the main aspects. • reference to undercuts, complex features and the difficulty of removing injection moulded parts from their moulds • reference to how difficulties could be overcome.	Candidate demonstrates sound knowledge of the subject matter and a secure understanding of the main aspects. • clear reference to undercuts, complex features and the difficulty of removing injection moulded parts from their moulds • detailed reference to how difficulties could be overcome.

Question			Expected response	Max mark	Additional guidance
4.	(a)		Candidates are expected to describe how the designers could ensure the Flume bath is comfortable and easy to use for its intended user group. Although there is an underlying body of design knowledge required to answer it, there is a wide range of possible answers. The question is therefore marked holistically. The features which are looked for are knowledge of the subject matter, ability to comprehend the question and to construct an answer which uses clear examples to support the points made. Typical answers are likely to include • researching the target market — observation, surveys • consult an ergonomist • applying ergonomic data • modelling — test rigs and prototypes • user trip • user trials.	**4**	Award marks using the best fit characteristics shown below. Do not award a mark for simply stating, for example, the designer could have carried out user trips, trials and tested their idea using models and test rigs. Response must be appropriate to Advanced Higher level and provide a description with appropriate detail with reference to the Flume bath. *The partial response below exemplifies the detail looked for at this level. It was taken from a full answer that was awarded marks in the top band.* The designer could have carried out their own user trips to give them a better understanding of the problems associated with taking a bath. However, to provide useful information, the designer would have had to simulate the restrictions faced by the users. This can be done by using an 'empathy suit' that would have restricted the movements of the designer and provided a greater insight into the need of the users.

An answer which falls into these categories may do so for a number of reasons. It is likely that		
0–1 marks	**2–3 marks**	**4 marks**
Candidate demonstrates a limited knowledge and understanding of the subject matter. • limited reference to methods and activities to ensure comfort and ease of use • little consideration of the information required • limited reference to the Flume bath • detail is limited • few points are made that address the question.	Candidate demonstrates knowledge of the subject matter and an understanding of the main aspects. • reference to appropriate methods and activities to ensure comfort and ease of use • consideration of the information required • reference to the Flume bath • detail is effective.	Candidate demonstrates sound knowledge of the subject matter and a secure understanding of the main aspects. • clear reference to appropriate methods and activities to ensure comfort and ease of use • good consideration of the information required • specific reference to the Flume bath • detail is highly effective.

Question			Expected response	Max mark	Additional guidance
	(b)		Candidates are expected to describe the benefits and drawbacks of using 'Just-in-time' production. Although there is an underlying body of design knowledge required to answer it, there is a wide range of possible answers. The question is therefore marked holistically. The features which are looked for are knowledge of the subject matter, ability to comprehend the question and to construct an answer. Typical answers are likely to include Benefits • efficiency due to — zero lead times — zero stock levels — known level of demand — limited storage required — improved cash flow • flexibility • reduction in costs • reduction in waste. Drawbacks • reliant on suppliers • reliant on logistics/deliveries.	**4**	Award marks using the best fit characteristics shown below. Do not award a mark for simply stating, for example, a benefit of using 'Just-in-time' production is that it is efficient and flexible. The drawbacks are that it needs a reliable supply of materials. Response must be appropriate to Advanced Higher level and provide a description with appropriate detail. *The partial response below exemplifies the detail looked for at this level. It was taken from a full answer that was awarded marks in the top band.* Material costs are reduced as stock is only bought when required which saves money on storage and reduces waste.

An answer which falls into these categories may do so for a number of reasons. It is likely that		
0–1 marks	**2–3 marks**	**4 marks**
Candidate demonstrates a limited knowledge and understanding of the subject matter. • limited reference to benefits and/or drawbacks of 'Just-in-time' • limited and vague reference to features of 'Just-in-time' • detail is limited • few points are made that address the question.	Candidate demonstrates knowledge of the subject matter and an understanding of the main aspects. • reference to benefits and/or drawbacks of 'Just-in-time' • reference to specific features of 'Just-in-time' • detail is effective • points made address the question.	Candidate demonstrates sound knowledge of the subject matter and a secure understanding of the main aspects. • reference benefits and drawbacks • reference to specific features of 'Just-in-time' • detail is highly effective • most points made address the question.

Question			Expected response	Max mark	Additional guidance
	(c)		Candidates are expected to describe the benefits and drawbacks to a manufacturer of obtaining a Kitemark from the BSI. Although there is an underlying body of design knowledge required to answer it, there is a wide range of possible answers. The question is therefore marked holistically. The features which are looked for are knowledge of the subject matter, ability to comprehend the question and to construct an answer. Typical answers are likely to include • confidence in product • quality assurance • legal protection • improved reputation • increased exports • improved marketing.	**4**	Award marks using the best fit characteristics shown below. Do not award a mark for simply stating, for example, the benefit of obtaining a Kitemark is that it provides quality assurance and legal protection. Response must be appropriate to Advanced Higher level and provide a description with appropriate detail. *The partial response below exemplifies the detail looked for at this level. It was taken from a full answer that was awarded marks in the top band.* A benefit of obtaining a Kitemark from the BSI is that the Kitemark provides a visual symbol that tells the consumer the product has been manufactured to the highest standard which will improve the reputation of the manufacturer and could improve sales.

An answer which falls into these categories may do so for a number of reasons. It is likely that		
0–1 marks	**2–3 marks**	**4 marks**
Candidate demonstrates a limited knowledge and understanding of the subject matter. • limited reference to benefits and/or drawbacks **to the manufacturer** of obtaining a Kitemark • detail is limited • few points are made that address the question.	Candidate demonstrates knowledge of the subject matter and an understanding of the main aspects. • reference to benefits and/or drawbacks **to the manufacturer** of obtaining a Kitemark • detail is effective • points made address the question.	Candidate demonstrates sound knowledge of the subject matter and a secure understanding of the main aspects. • reference to benefits and drawbacks **to the manufacturer** of obtaining a Kitemark • detail is highly effective • most points made address the question.

Question			Expected response	Max mark	Additional guidance
5.	(a)		Candidates are expected to describe the challenges faced by designers when developing a radical design concept, compared to making incremental changes to an existing product. Although there is an underlying body of design knowledge required to answer it, there is a wide range of possible answers. The question is therefore marked holistically. The features which are looked for are knowledge of the subject matter, ability to comprehend the question and to construct an answer. Typical answers are likely to include • understanding/analysing the problem • generating solutions/rethinking traditional concepts • research/gathering information • applying technologies for a new purpose • working with the unknown • time • economics.	**4**	Award marks using the best fit characteristics shown below. Do not award a mark for simply stating, for example, the challenge of working with the unknown and using new materials and untested technologies. Response must be appropriate to Advanced Higher level and provide a description with appropriate detail with reference to developing radical design concepts. *The partial response below exemplifies the detail looked for at this level. It was taken from a full answer that was awarded marks in the top band.* The first challenge is where to start. Incremental changes start with the existing product and focus on minor alteration and improvements. A radical approach requires the designer to avoid what has been done before and take a totally new approach. This can be very difficult as preconceived ideas and existing approaches can be difficult to avoid.

An answer which falls into these categories may do so for a number of reasons. It is likely that		
0–1 marks	**2–3 marks**	**4 marks**
Candidate demonstrates a limited knowledge and understanding of the subject matter. • vague reference to challenges of developing radical design concepts • vague/little comparison to incremental development • detail is limited • few points are made that address the question.	Candidate demonstrates knowledge of the subject matter and an understanding of the main aspects. • reference to challenges to designers of developing radical design concepts • comparisons to incremental development • detail is effective • points made address the question.	Candidate demonstrates sound knowledge of the subject matter and a secure understanding of the main aspects. • reference to a range of challenges to designers of developing radical design concepts • comparisons made between radical and incremental development • detail is highly effective • most points made address the question.

Question			Expected response	Max mark	Additional guidance
	(b)		Candidates are expected to outline the potential risks of launching a radical product **and** explain how they may be overcome. Although there is an underlying body of design knowledge required to answer it, there is a wide range of possible answers. The question is therefore marked holistically. The features which are looked for are knowledge of the subject matter, ability to comprehend the question and to construct an answer which uses clear examples to support the points made. Typical answers are likely to include **Risk** • lower than expected sales • market doesn't accept radical product • market doesn't trust new approach or technology • consumers' buying patterns can be changed • new technology might fail • radical products could damage reputation • product might fail and lose market share. **Methods to overcome** • informative advertising campaign • endorsements • branding.	**4**	Award marks using the best fit characteristics shown below. Do not award a mark for simply stating, for example, the product might not sell which could be overcome by a successful advertising campaign. Response must be appropriate to Advanced Higher level and outline the risks associated with launching a radical product, and provide an explanation with appropriate detail on how they could be overcome. *The partial response below exemplifies the detail looked for at this level. It was taken from a full answer that was awarded marks in the top band.* A potential risk of launching a radical product is that the product will be perceived as too advanced by the consumer and they will not believe it will work. Informative advertising campaigns can be used to educate the consumers and gain their trust.

An answer which falls into these categories may do so for a number of reasons. It is likely that		
0–1 marks	**2–3 marks**	**4 marks**
Candidate demonstrates a limited knowledge and understanding of the subject matter. • vague outline of risks of launching radical products • vague/little reference to strategies for reducing risk of launching radical products • detail is limited • few points are made that address the question.	Candidate demonstrates knowledge of the subject matter and an understanding of the main aspects. • outline of risks of launching radical products • reference to a method(s) for reducing risk of launching radical products • detail is effective • points made address the question.	Candidate demonstrates sound knowledge of the subject matter and a secure understanding of the main aspects. • clear outline of risks of launching radical products • reference to method(s) for reducing risk of launching radical products • detail is highly effective.

Question			Expected response	Max mark	Additional guidance
	(c)		Candidates are expected to explain why a patent is suitable for protecting radical design concepts. Although there is an underlying body of design knowledge required to answer it, there is a wide range of possible answers. The question is therefore marked holistically. The features which are looked for are knowledge of the subject matter, ability to comprehend the question and to construct an answer which uses clear examples to support the points made. Typical answers are likely to include • cover ideas/concept as well as products • initially cheap to obtain £230–£280 in the UK for new companies developing ideas • lasts for 20 year giving time to develop idea commercially • idea can be sold as a concept to raise capital • patent can be leased to raise capital • prevents competitors using ideas • provides/maintains a competitive edge in market.	**3**	Award marks using the best fit characteristics shown below. Do not award a mark for simply stating, for example, a patent protects the intellectual property rights of the designer. Response must be appropriate to Advanced Higher level and provide an explanation with appropriate detail that references radical design concepts. *The partial response below exemplifies the detail looked for at this level. It was taken from a full answer that was awarded marks in the top band.* A patent can be obtained that protects the intellectual property of an idea or a concept. The designer does not have to prove the idea works or produce a physical product.

An answer which falls into these categories may do so for a number of reasons. It is likely that		
0–1 marks	**2 marks**	**3 marks**
Candidate demonstrates a limited knowledge and understanding of the subject matter. • little reference to features of a patent • vague/little reference to radical design concepts • detail is limited • few points are made that address the question.	Candidate demonstrates knowledge of the subject matter and an understanding of the main aspects. • reference to features of a patent • reference to radical design concepts • detail is effective.	Candidate demonstrates sound knowledge of the subject matter and a secure understanding of the main aspects. • detailed reference to features of a patent • specific reference to radical design concepts • detail is highly effective.

Question			Expected response	Max mark	Additional guidance
6.	(a)		Candidates are expected to describe the benefits CAD provides when developing products such as the RoboWorm. Although there is an underlying body of design knowledge required to answer it, there is a wide range of possible answers. The question is therefore marked holistically. The features which are looked for are knowledge of the subject matter, ability to comprehend the question and to construct an answer which uses clear examples to support the points made. Typical answers are likely to include • effective communication between design team • enhanced graphics • facilitates changes to design work • can be used to test aspects of the product's design and manufacture • can simulate tests that can't be carried out on models and prototypes • reduces the need to manufacture physical models • can be linked to CNC machines and or 3D printers to create physical models.	**3**	Award marks using the best fit characteristics shown below. Do not award a mark for simply stating, for example, CAD improves communication and facilitates change. Response must be appropriate to Advanced Higher level and provide a description with appropriate detail. *The partial response below exemplifies the detail looked for at this level. It was taken from a full answer that was awarded marks in the top band.* Recording and documenting changes is easier using CAD as there is no need to redraw the design when making changes. This increases the likelihood that changes will be made even at a late stage in the design process which improves the design of products such as the RoboWorm.

An answer which falls into these categories may do so for a number of reasons. It is likely that		
0–1 marks	**2 marks**	**3 marks**
Candidate demonstrates a limited knowledge and understanding of the subject matter. • generic reference to benefits of CAD • vague/little reference to stages of development • vague/little reference to products • detail is limited • few points are made that address the question.	Candidate demonstrates knowledge of the subject matter and an understanding of the main aspects. • reference to benefits of CAD • reference to stages of development • reference to products • detail is effective • points made address the question.	Candidate demonstrates sound knowledge of the subject matter and a secure understanding of the main aspects. • detailed reference to benefits of CAD • specific reference to stages of development • detailed reference to products • detail is highly effective.

Question			Expected response	Max mark	Additional guidance
	(b)		Candidates are expected to explain why 3D printing the RoboWorm resulted in a reduction in manufacturing costs. Although there is an underlying body of design knowledge required to answer it, there is a wide range of possible answers. The question is therefore marked holistically. The features which are looked for are knowledge of the subject matter, ability to comprehend the question and to construct an answer which uses clear examples to support the points made. Typical answers are likely to include • less machinery required • less tooling required • reduction in parts • reduction in assembly • less material used • complex/moving parts • volume of production • highly automated • reduction in workforce.	**4**	Award marks using the best fit characteristics shown below. Do not award a mark for simply stating, for example, it's cheaper to manufacture because it's made from plastic. Response must be appropriate to Advanced Higher level and provide an explanation with appropriate detail that references the RoboWorm's manufacture. *The partial response below exemplifies the detail looked for at this level. It was taken from a full answer that was awarded marks in the top band.* 3D printing is a fully automated process that reduces the amount of labour and skill required to manufacture the RoboWorm and reduces the cost of its manufacture.

An answer which falls into these categories may do so for a number of reasons. It is likely that		
0–1 marks	**2–3 marks**	**4 marks**
Candidate demonstrates a limited knowledge and understanding of the subject matter. • vague/general reference to 3D printing impact on manufacturing costs • little reference to RoboWorm • detail is limited • few points are made that address the question.	Candidate demonstrates knowledge of the subject matter and an understanding of the main aspects. • reference to 3D printing and impact on manufacturing costs • general reference to RoboWorm's manufacture • detail is effective • points made address the question.	Candidate demonstrates sound knowledge of the subject matter and a secure understanding of the main aspects. • detailed reference to 3D printing and impact on manufacturing costs • specific reference to the RoboWorm's manufacture • detail is highly effective • most points made address the question.

Question			Expected response	Max mark	Additional guidance
	(c)		Candidates are expected to outline the steps a manufacturer can take to ensure their products are manufactured and assembled to the highest standard. Although there is an underlying body of design knowledge required to answer it, there is a wide range of possible answers. The question is therefore marked holistically. The features which are looked for are knowledge of the subject matter, ability to comprehend the question and to construct an answer which uses clear examples to support the points made. Typical answers are likely to include • quality checks – materials, components, machinery • training and monitoring of staff • sampling and testing.	**4**	Award marks using the best fit characteristics shown below. Do not award a mark for simply stating, for example, check materials, train staff and test finished product. Response must be appropriate to Advanced Higher level and provide a clear outline. *The partial response below exemplifies the detail looked for at this level. It was taken from a full answer that was awarded marks in the top band.* The machinery can be checked and recalibrated regularly. Any faulty or worn machinery can be replaced.

An answer which falls into these categories may do so for a number of reasons. It is likely that		
0–1 marks	**2–3marks**	**4 marks**
Candidate demonstrates a limited knowledge and understanding of the subject matter. • limited reference to stages of manufacture • little reference to quality assurance of manufacture and/or assembly • few points are made that address the question • detail is limited.	Candidate demonstrates knowledge of the subject matter and an understanding of the main aspects. • reference to stages of manufacture • reference to quality assurance of manufacture and/or assembly • points made address the question • detail is effective.	Candidate demonstrates sound knowledge of the subject matter and a secure understanding of the main aspects. • specific reference to stages of manufacture • detailed reference to quality assurance of manufacture and assembly • most points made address the question • detail is highly effective.

Question			Expected response	Max mark	Additional guidance
	(d)		Candidates are expected to outline the consequences of a product recall for a company. Typical answers are likely to include • cost of recall • loss of confidence • loss of reputation • loss of market share • damage to brand • damage to other associated products.	**3**	**Award 1 mark** for each appropriate consequence outlined. Do not award a mark for simply stating, for example, the brand image will be damaged. Response must be appropriate to Advanced Higher level and provide a clear outline. *The partial response below exemplifies the detail looked for at this level. It was taken from a full answer that was awarded **3 marks**.* Product recalls can have a devastating effect on brand image. If the situation is not handled correctly the brand could be damaged which will have a negative impact on other products that are sold under the same brand name.

[END OF SPECIMEN MARKING INSTRUCTIONS]