H

National
Qualifications
SPECIMEN ONLY

SQ10/H/01 Design and Manufacture

Date — Not applicable

Duration — 2 hours

Total marks — 70

SECTION 1 — 25 marks

Attempt ALL questions.

SECTION 2 — 45 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.

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SQ10H01

SECTION 1 — 25 marks

Attempt ALL questions

1. Two bread bins are shown with product information.

Armadillo bread bin

Materials

- Base — beech
- Lid sections — aluminium
- Handles, hinges and slide guides — ABS

Retail price — £89.99

Joseph Joseph Bread bin

Materials

- Body — melamine
- Lid — beech

Retail price — £50.00

MARKS

Question 1 (continued)

(a) Explain why the materials chosen for each of these products are suitable. You should make **six** valid points. You do not need to cover all materials but should cover both products in your answer. **6**

(b) Name **three** appropriate mass manufacturing processes used in the production of these bread bins **and** explain why they are suitable. You should cover both products in your answer but may refer to different processes for each. **6**

(c) Describe the aesthetic appeal of each bread bin. Your answer should cover **four** different aesthetic aspects. **4**

(d) Describe **five** functional issues that will have influenced the design of each of these products. **5**

(e) Explain how any **four** production and planning systems can be used to improve production efficiency. **4**

MARKS

SECTION 2 — 45 marks

Attempt ALL questions

2. The body of the paper punch shown below is made from mild steel sheet and has been manufactured by piercing and blanking.

(a) Explain **two** advantages of piercing and blanking the body. **2**

(b) Explain **two** reasons for using carbon steel for the cutting blades. **2**

(c) Describe how the design of this product has been influenced by anthropometrics and physiology. **3**

3. A golf trolley is shown below. The golf bag and clubs are carried on the trolley for ease of transportation when playing golf.

The designer was given an open brief for this product.

(a) Describe **one** advantage and **one** disadvantage of an open brief. **2**

(b) Explain in what ways the designer would make use of any **three** pieces of research information when designing the golf trolley. **3**

(c) Describe **two** different ways in which user trials could be used to evaluate the function of the golf trolley. **2**

MARKS

4. The opportunity for new products can arise from technology push or market pull.

(a) Describe how **two** aspects of the design of a product with which you are familiar has been influenced by:

(i) technology push **2**

(ii) market pull. **2**

Many popular products are branded.

(b) Explain **two** benefits of branding products for each of the following:

(i) the manufacturer **2**

(ii) the consumer. **2**

MARKS

5. A bicycle is shown below.

Pinarello cycle

Detail of carbon-fibre seat post

A number of different prototypes were used during the development of the bicycle.

(a) Describe **three** ways in which prototypes could be used to gather specific information during the bicycle's development. **3**

Computer technologies were used during the development of the bicycle.

(b) Explain **two** benefits of using each of the following computer technologies in the development of the bicycle.

(i) CAD **2**

(ii) Rapid prototyping **2**

During the development of the bicycle the designer would have worked with a number of specialists within the design team.

(c) Describe **two** aspects of the role of each of the following specialists in the development of the bicycle.

(i) Market researcher **2**

(ii) Materials technologist **2**

Standard components were used in the manufacture of the bicycle.

(d) Describe **two** benefits of using standard components. **2**

The bicycle seat post was made from carbon-fibre which is a composite material.

(e) Describe **two** benefits of using composite materials. **2**

MARKS

6. Product design teams have a shared responsibility to design for sustainable development in order to protect the environment.

Explain how consideration for the environment has impacted on the design and manufacture of products with which you are familiar. **8**

[END OF SPECIMEN QUESTION PAPER]

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Section 1, Question 1	Image of Joseph Joseph bread bin is reproduced by kind permission of Joseph Joseph Ltd.
Section 2, Question 2	Image from www.shutterstock.com
Section 2, Question 3	Image of Masters I Cart Zero Three Wheel Golf Trolley is reproduced by kind permission of The Masters Golf Company Ltd.
Section 2, Question 3	Image of golf bag from www.shutterstock.com
Section 2, Question 5	Two images of Pinarello bicycle are reproduced by kind permission of Cicli Pinarello S.p.A.

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SQ10/H/01 **Design and Manufacture**

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 Higher Design and Manufacture

This information is provided to help you understand the general principles you must apply when marking candidate responses to questions in this Paper. These principles must be read in conjunction with the detailed marking instructions, which identify the key features required in candidate responses.

(a) Marks for each candidate response must always be assigned in line with these General Marking Principles and the Detailed Marking Instructions for this assessment.

(b) Marking should always be positive. This means that, for each candidate response, marks are accumulated for the demonstration of relevant skills, knowledge and understanding: they are not deducted from a maximum on the basis of errors or omissions.

(c) For each candidate response, the following provides an overview of the marking principles. Refer to the specific Marking Instructions for further guidance on how these principles should be applied.

(i) Questions that ask candidates to **describe**

Candidates must provide a statement or structure of characteristics and/or features. This should be more than an outline or a list. Candidates may refer to, for instance, a concept, experiment, situation, or facts in the context of and appropriate to the question. Candidates will normally be required to make the same number of factual/appropriate points as are awarded in the question.

(ii) Questions that ask candidates to **explain**

Candidates must generally relate cause and effect and/or make relationships between things clear. This will be related to the context of the question or a specific area within a question.

Marking Instructions for each question

SECTION 1

Question			Expected response	Max mark	Additional guidance
1	**a**		Candidate explanations should relate the materials chosen to identified aspects, features, parts and/or components of the product(s) and will include properties/benefits/characteristics of materials.	**6**	Valid explanations of six choices at 1 mark each. Candidates may focus more of their response on one product than the other, but must still cover both products in their response. Properties/benefits/characteristics of materials are likely to be drawn from: • durability of material *(corrosion resistant/non-corroding, scratch resistant, impact resistant)* • availability of materials (eg standard forms of supply) • strength to weight considerations • safety issues associated with material choice • rigidity • suitability for production methods • function of component parts • aesthetic properties • ease of cleaning/hygiene • recycling • cost. eg Melamine has been used in the Joseph Joseph bread bin as this material is recognised as being hygienic/resistant to bacteria/easy to clean. Any other valid material property explained in relation to an identified feature/function.
1	**b**		The candidate will have named and explained three of the types of mass	**6**	Any three appropriate mass manufacturing processes and their relationships

Question			Expected response	Max mark	Additional guidance
			manufacturing processes used in the production of the illustrated products, and how production processes relate to the materials used.		regarding suitability explained. Maximum of 3 marks for naming of processes (1 mark each process). Maximum of 3 marks for explanations of suitability (1 mark each explanation). Processes may be repeated across the two products where appropriate. Processes are likely to be drawn from: • **Armadillo** bread bin — spindle moulding, machine router, piercing and blanking, bending and forming, injection moulding • **Joseph Joseph** bread bin — machine router, thermoset injection moulding, compression moulding, drilling. Suitability of the mass manufacturing processes should relate to the ways in which the processes/manufacturing/assembly techniques named are influenced by volume of production. This can include explanations of suitability which refer to: • standardisation of components/sizes, component parts all the same size. No further finishing required. Process related to shape of component • repeatability and accuracy. Economies of scale — mass/continuous production or any other appropriate aspect.
1	**c**		The candidate is expected to describe any four aspects of each of the products in relation to the aesthetic appeal.	**4**	Four descriptions at 1 mark each. Candidates may describe one product more than the other but must still cover both products in their response. Aesthetic appeal is likely to be described in terms of: • shape/form

Question			Expected response	Max mark	Additional guidance
					• colour • proportion • contrast/harmony • pattern • line • texture • balance • fashion • style • market trends. eg the Armadillo bread bin uses a modern style (1 mark) and has a metallic appearance (1 mark) making it attractive to a contemporary or modern market (1 mark). It has a repeating pattern in the opening lid sections (1 mark). The Joseph Joseph and the Armadillo bread bins use contrast (1 mark) in natural (wood) and manufactured materials (metals and plastics) (1 mark). The Joseph Joseph bread bin uses bright colour to attract its market (1 mark), this could contrast or harmonise with a particular kitchen design or user tastes (1 mark).
1	**d**		The candidate is expected to describe any five functional issues and have covered aspects of both products. These can be the same issue or different issues.	**5**	Five issues identified at 1 mark each. Any five functional issues described, likely to be drawn from: • the need to store/access bread/bread items (size)

Question			Expected response	Max mark	Additional guidance
					• the need to keep items fresh/safely stored away from the environment (closes) • the ability to withstand continual/repeated use (durability) • the need for stability when on a surface/counter top • the need to be easy to clean/hygienic • the need to be easy to use • the need for the functionality to be safe. (eg accessibility, open, close, carry, clean) • the safety aspects relating to production. (eg noise, dust, safety equipment) • the ease and safety of maintenance issues • the ease of moving, lifting and carrying • the multiple use of components (use of lid as bread board — Joseph Joseph only) or any other appropriate functional descriptions.
1	**e**		Candidates are expected to explain how any four planning systems can be used to improve production efficiency.	**4**	Four explanations at 1 mark each. Examples are likely to include planning systems (with a related explanation on improving production efficiency) which could include: • use of correct production type (batch/mass/flow) • Gantt charts • flowcharts • use of CNC, CAD/CAM

Question			Expected response	Max mark	Additional guidance
					• jigs/patterns • JIT • standard components • sub-contracting or any other appropriate planning system and efficiency explanation.

SECTION 2

Question			Expected response	Max mark	Additional guidance
2	**a**		The candidate is expected to explain the advantages of piercing and blanking as it relates to the production of the paper punch. Responses are likely to draw from any **two** of the following characteristics of piercing and blanking: • dimensional accuracy • repeatability • part remains flat • small holes possible (depending on material thickness) • multiple features can be produced simultaneously • more economical for large production runs or any other suitable characteristic.	**2**	Two appropriate explanations at 1 mark each. eg Piercing and blanking is a mass production process. Many paper punches will be made at the same time, so this process makes it more economical (1 mark). Piercing and blanking allows multiple features of the punch to be produced at the same time, eg the top hole, the overall shape, or the top and side shapes (1 mark). Piercing and blanking is a dimensionally accurate process. This is important to ensure that all components fit together easily/effectively/accurately on a multiple production run (1 mark).
2	**b**		The candidate is expected to give two explanations as to why a carbon steel is an appropriate choice for material and is likely to draw from the fact that carbon steels are:	**2**	Two appropriate explanations at 1 mark which relate a feature of carbon steel to its use/selection for the cutting blades. eg

Question			Expected response	Max mark	Additional guidance
			• harder than mild steel • stronger than mild steel • able to keep an edge for a long period — durability • able to be tempered or any other suitable explanation.		Carbon steel is harder than mild steel and is less likely to wear in repeated punching operations (1 mark). Carbon steel keeps an edge for a long period. This is important to ensure that the cutting blades last a long time over the life of the product (1 mark).
2	c		The candidate is expected to give three descriptions from anthropometrics and physiology. Aspects are likely to be drawn from: For anthropometrics • width of handle • length of handle • no finger traps For physiology • force required to operate • force required to reset • easy to open/close for emptying	3	Three appropriate descriptions at 1 mark each. eg The width of the handle is important for the paper punch to ensure that it is comfortable for most users to operate/fits most users' hands (1 mark). It is important that there are no finger traps as this product is used with a degree of force. Finger traps could cause significant injury (1 mark). The amount of force required to operate the punch is important as a range of users will operate the punch — from children, adults, to potentially those with physical disability needs. The amount of force required should be minimal/reasonable (1 mark). The force required to reset the punch is important (spring). The punch should not require to be physically pulled to reset it (1 mark). The paper punch should be easy to open/close for emptying as this will be a regular requirement for the operator (1 mark).
3	a		The candidate is expected to describe one advantage and one disadvantage of an open brief.	2	Any two descriptions at 1 mark each. The answer must include one advantage and one disadvantage.

Question			Expected response	Max mark	Additional guidance
					• An open brief would give the designer more creative freedom. • An open brief would enable the possibility of more innovative ideas. • An open brief could lead the designer to produce designs that are unsuitable.
3	**b**		The candidate is expected to explain any three logical uses of information gained from research activities. In their answer, it is likely that candidates will make reference to aspects of the golf trolley design, such as: • size of a typical golf bag • height of a user's hand when standing/walking • grip size for typical users • likely terrain that the trolley would be used on • weight of a typical set of golf clubs • weather conditions • physical capability of users (strength, etc) or any other logical design aspect.	**3**	Explanations for three pieces of research information at 1 mark each. eg • The designer would have to consider the dimensions for a typical golf bag to ensure the trolley fits as many bags as possible. This would make it attractive to a larger part of the market/be attractive to more users/customers (1 mark). • The designer would use the average height of a user's hand when walking as this would affect the handle height design/user comfort/user fatigue (1 mark). • The designer would consider the weather conditions in which the trolley will be used. This can include heat, cold and moisture, and this will affect the choices of suitable materials (1 mark).
3	**c**		The candidate is expected to describe two different ways in which user trials could be carried out. Answers could refer to user trials such as:	**2**	Two appropriate user trial descriptions at 1 mark each. Sample answer: A range of users could be asked to use the trolley in various situations, eg up and

Question			Expected response	Max mark	Additional guidance
			• observations (of the trolley in use by different users/in different conditions/on different golf courses) • different types of bag (which could be attached to the trolley to check if they fit and can be removed easily) • loading (the trolley could be fitted with a fully loaded golf bag to check if there is any bending or failure of parts) • environmental conditions (the trolley could be subjected to water, mud, sand, etc to check if there is any corrosion or excess wear and tear) • user range/type (the trolley could be given to a range of users and assessed on how easy it is to fold/assemble/pack) • portability (the trolley could be tested on how easily it packs/fits into a small car/typical car/form of public transport).		down a hill, on rough ground, wet grass etc (1 mark) and comment on how easy it was to push or pull the trolley in those conditions (1 mark).
4	**a**	**i**	The candidate is expected to describe two technology push aspects of a product. It is likely that candidates will draw from	**2**	Two appropriate descriptions at 1 mark each. eg in the case of a games console: Technology push has influenced games consoles through the introduction of

Question			Expected response	Max mark	Additional guidance
			common technology push aspects such as: • touch screen technology • 3D graphics ability • miniaturisation • wi-fi capability • improving audio technology • improvements in graphics/video technology • compatibility with existing products/previous version(s) of product • increased memory capability • 'cloud' storage or any other suitable technology push aspect.		wireless capability, allowing users to move around when playing/play in cafes/shops (1 mark). Also, component parts are able to be made in smaller sizes and are more powerful. This allows the consoles to reduce in size/be portable whilst at the same time having more memory/being able to run more complex games applications (1 mark).
4	**a**	**ii**	The candidate is expected to describe two market pull aspects of a product. It is likely that candidates will draw from common market pull aspects such as: • need for accessibility • affordability • portability • improved quality (eg sound, graphics, longevity) • online features • compatibility with existing	**2**	Two appropriate descriptions at 1 mark each (no marks awarded for repetition from a(i) above). eg in the case of a games console: Market pull has influenced the games console through people wanting to be able to 'game' on the move, so they are designed smaller to make them more portable (1 mark). People also want, depending on the type of game, a more life-like experience which has led to designers working to improve the graphics and sounds (1 mark). The age of the user influences the ergonomics, to ensure they are able to physically use them (1 mark).

Question			Expected response	Max mark	Additional guidance
			products/previous version(s) of products • different pull from different age groups or any other suitable market pull aspect.		
4	b	i	Candidates are expected to explain two benefits of branding for the manufacturer. Explanations are likely to refer to benefits such as: • making use of/continuing market identity • commanding a price • creating customer loyalty • providing a platform for growth.	2	Two appropriate explanations at 1 mark each. eg Branding for the manufacturer means that they can be identified easily in a competitive marketplace (1 mark) and also use their brand to influence the prices at which their products sell (1 mark).
4	b	ii	Candidates are expected to explain two benefits of branding for the customer. Explanations are likely to refer to benefits such as: • market identity • value for money • consumer loyalty • expectation of quality • enabling choice.	2	Two appropriate explanations at 1 mark each (no marks awarded for repetition from b(i) above). eg Branding means that consumers can easily identify the company which the products belong to (1 mark) allowing them to make choices, possibly based on previous experience/reputation/product reviews of the quality/features/reliability for that brand (1 mark).
5	a		Candidates are expected to describe the use of prototypes during the	3	Three appropriate descriptions at 1 mark each.

Question			Expected response	Max mark	Additional guidance
			development phases of a bicycle. Descriptions are likely to refer to uses such as: • setting sizes of the bicycle during user trials • helping to decide the manufacturing processes • gathering feedback on aesthetics • gathering marketing feedback • providing feedback on the fit and comfort of the bicycle for the user • providing feedback on use and handling of the bicycle • conducting an analysis on how strong the bicycle is (stress analysis) and how it would stand up to typical riding conditions • providing information on how well all of the parts fit together or any other logical prototype use.		eg Prototypes could be used to set the sizes of the bicycle during user trial (1 mark). A prototype could be used to gather information on the aesthetics of the bicycle (1 mark). A prototype could be used to gather information/feedback on the comfort of the saddle (1 mark). Alternatively a more detailed statement on one of the above methods could attract more than 1 mark. eg Prototypes could be used to set the sizes of the bicycle during user trial (1 mark). This would allow the gathering of information relating to the frame/ position of handle bars/pedal crank/location of brakes, etc (1 mark) or as a racing cycle, if it meets the regulations of competition sport (1 mark).
5	**b**	**i**	The candidate is expected to explain two benefits CAD would offer during the bicycle's development. It is likely that these explanations will refer to benefits such as: • making it easier to alter the design	**2**	Two appropriate explanations at 1 mark each. eg CAD can make it easier to make alterations to the design. This avoids having to completely redraw aspects of the bicycle's design (1 mark). CAD can make it easier to communicate with other members of the design team as much of the design work can be e-mailed or communicated across the team(s)

Question			Expected response	Max mark	Additional guidance
			• a library of parts could be used to speed up the production of designs • carrying out stress analysis on parts/components before prototyping/manufacture • the design can be easily rendered to provide visuals for clients • easier to communicate design information with other members of the design team or any other appropriate explanation.		using digital technology (1 mark).
5	**b**	**ii**	The candidate is expected to explain two benefits rapid prototyping would offer during the bicycle's development. It is likely that these explanations will refer to benefits such as: • it will allow the designer to make prototypes of component parts of the bicycle without the need for investing in expensive moulding tools • parts can be tested and easily modified where required • some RP processes use materials such as ABS that may be used in the final product • it speeds up the design process.	**2**	Two appropriate explanations at 1 mark each (answers cannot be repeated from 5(b)(i)). eg Rapid prototyping will allow the designer to make prototype component parts of the bicycle without the need for investment in expensive processing equipment/ moulds/dies thus saving money (1 mark). Rapid prototyping can often use materials that are the final component material. This would allow proper testing of the component (1 mark).

Question			Expected response	Max mark	Additional guidance
5	**c**	**i**	The candidate is expected to describe two aspects of the role of a market researcher. It is likely that the descriptions will include aspects of the role such as: • pricing • market profiling • selling • usage • aesthetics or any other logical aspect of the role. The market researcher may also contribute, eg by working with other team members.	**2**	Two appropriate descriptions at 1 mark each. eg • Providing suitable price range information for intended market. • Providing a profile of the intended market (age, sex, disposable income, preferences, etc). • Suggesting/identifying likely outlets where the user would purchase the product/product could be sold. • Providing information on the way in which the bicycle would be used (ie racing, commuting, etc). • Suggesting the likely colours and styles for the bicycle. The market researcher could contribute to the team by: • helping to draw up a product specification • assisting the team/designer in the selection of appropriate ideas that would suit the target market.

Question			Expected response	Max mark	Additional guidance
5	c	ii	The candidate is expected to describe two aspects of the role of a market researcher. It is likely that the descriptions will include aspects of the role such as: • technical information/data • testing • production or any other logical aspect of the role.	2	Two appropriate descriptions at 1 mark each. eg • Providing the technical information on appropriate materials that could be used for different parts of the bike. • Providing information on new materials that could be used. • Carrying out testing on the materials proposed for the bicycle to confirm if they will function/cope under normal working conditions. • Advising on production methods.
5	d		The candidate is expected to describe two benefits of standard components. Any logical benefit is acceptable.	2	Two appropriate descriptions at 1 mark each. It is likely that the descriptions will refer to benefits such as: • Standard components can be manufactured in large quantities which can keep costs down • Standard components can be supplied in standard sizes which helps during designing • Standard components generally have the same quality (quality assured) • The focus for design can be on the shape/form/technicality/performance of the cycle without over concern for standard components (bolts, nuts/screws/bearings, etc) • Production speed can be improved as there is often no need to keep changing assembly tools for non-standard/different components.
5	e		The candidate is expected to describe two benefits of composite materials. Descriptions are likely to refer to	2	Two appropriate descriptions at 1 mark each. It is likely that the descriptions of the benefits of composite materials will

Question			Expected response	Max mark	Additional guidance
			aspects/features or characteristics of composites such as: • performance • strength • combined properties/characteristics • cost or any other appropriate description of composite feature.		include: • Higher performance to given weight. • Laminated/composited materials are generally stronger. • Final materials share the properties of each material in the composite. • Easier to achieve smooth, aerodynamic shape and form. • Part cost can be reduced. • Production cost can be reduced. • Most composites offer excellent resistance to corrosion, chemicals and weathering (UV degradation).
6			This question is set to test the candidate's ability to present a reasoned discussion about a design issue. Although there is an underlying body of design knowledge required to answer it, there is a very wide range of possible answers. Therefore the question is marked holistically. The features which are looked for are knowledge of the subject matter, and ability to comprehend the question and construct an answer which uses clear examples to support the points made. The table below is designed to assist with the placing of answers within the full mark range.	**8**	Descriptions are likely to make reference to some of the aspects below: • efficient/innovative use of materials • use of 'green' materials • design for recycling, re-use, reduce, renew, respect • up-cycling • circular economy • design for re-use • obsolescence • consumer choice • transportation issues • waste management • packaging • efficient/environmental use of production and planning or any other appropriate aspect. Whilst the response can include these aspects, it should be noted that the candidate may include other topics depending on the product(s) referenced.

Marking scheme for question 6

An answer which falls into this category may do so for a number of reasons. It is likely that for:			
8-7 marks	6-5 marks	4-3 marks	2-0 marks
• Detailed knowledge of the subject matter and a secure understanding of all aspects will be demonstrated • The answer will be relevant to the question demonstrating a high level of comprehension • Very detailed reference to a few products (even a single product) or selected references	• Knowledge of the subject matter and a secure understanding of the main aspects will be demonstrated • The answer will be relevant to the question and demonstrate a good level of comprehension • Reference to a few products or selected references to a number of products • Several clear points are made and examples are used to support them	• Knowledge of the subject matter and a secure understanding of the main aspects will be demonstrated • The answer will be relevant to the question • Reference to at least one product • Although examples are used, points made are unclear	• Very little knowledge or understanding of the subject matter is demonstrated • There is little or no reference to products • Very few points are made • Much of the response does not answer the question • The answer is simply too thin

[END OF SPECIMEN MARKING INSTRUCTIONS]