National
Qualifications
2016

2016 Design and Manufacture

Higher

Finalised Marking Instructions

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 for the scooters and or their component parts/features. It should include the properties or benefits of the materials.	6	Valid explanations of six different choices. Full marks can only be awarded where the candidate has included both scooters in their answer. **(Maximum 5 marks per product)** **No marks awarded for repetition of properties,/benefits or characteristics** **Beech plywood:** • Strength across both directions • Available in large sheets • Can take a variety of finishes • Cheaper than using natural woods Any other suitable explanation **Solid beech:** • Good strength to weight • Resistance to warping • Aesthetic qualities • Workability Any other suitable explanation **HDPE:** • Good chemical resistance which allows for it to be cleaned hygienically • Available in a range of colours • Durable • Can be left outside in a variety of weather conditions without fear of deterioration • Good strength, so can withstand the weight of child Any other suitable explanation

Question			Expected response	Max mark	Additional guidance
					Rubber: • Soft/pliable: Allowing it to be formed easily Providing shock absorbance from surfaces Can be assembled easily Good road surface contact Provides a non-slip surface for holding safely Any other suitable explanation **Aluminium:** • Corrosion resistant • Good strength to weight ratio • Lightweight (with explanation) • Suitable for the finishes employed • Suitable for recycling • Aesthetic qualities Any other suitable explanation **Nylon:** • Durable, resistant to wear • Self-lubricating, spins freely • Chemical resistance for cleaning Any other suitable explanation **Foam:** • Comfortable to hold • Provides a secure grip • Variety of colours Any other suitable explanation

Question			Expected response	Max mark	Additional guidance
					Stainless Steel: • Corrosion resistant • Tough • Durable • Aesthetic qualities Any other suitable explanation **eg** Beech plywood is suitable as it is available in wide boards and therefore **many sections can be made from the same sheet**, this would **reduce the amount of waste**. (1 mark) Aluminium is used in the manufacture of the scooter as it is a **strong yet lightweight metal and therefore easy for the children to move around**. It is also **non-corrosive making it suitable for outdoor use**. (2 marks)

Question			Expected response	Max mark	Additional guidance
	(b)		Candidates will name and explain why these are appropriate to the production of the scooters. It is likely that they will relate to the materials used.	**6**	Any three appropriate mass manufacturing processes and their relationships regarding suitability explained. Maximum of 3 marks for naming of processes (1 mark each process). Maximum of 3 marks for explanations of suitability. ***NB reference to mass production can only be awarded in Q1b*** One mark for each explanation of suitability; where more than one explanation is given to a process, a **maximum of two marks** per process should be awarded. **(Maximum of 5 marks per scooter)** ***NB Marks can be awarded for correct explanation of an incorrect process*** **Skate Scooter:** • Use of Templates/Jigs: to ensure consistency in size and accuracy of parts. To reduce time of repetitive tasks • CNC Routering/Spindle Moulding: to cut shaped sections (must make reference to CNC) clean finish, multiple sections of same shape cut together • Laminating of plywood • Drilling: creates holes for dowel – linked with JIGS • CNC lathe for turning handle and ends • Fixings: reference to standard components; benefits to manufacturer/ consumer • Injection moulding of wheels • Moulding of tyres • Die casting of fixings

Question			Expected response	Max mark	Additional guidance
					Kick scooter: • Extrusion of main body sections to provide continuous cross section • Piercing and blanking of component parts to provide slots for adjusting, and holes for fixing • Press forming to bend sheet blanks into shape • Injection moulding of wheels for intricacy in shape • Die casting of fixings **Statements could include:** • Repeatability of process • Accuracy of process • Economies of scale (Mass/Batch) • Forms suitable for process • Surface finish/No further finishing required • Adding strength (Press forming) **eg** The main body of the wooden scooter has been manufactured using a **CNC router**, this allows a **number of sections to be cut during one cycle.** Jigs would be used to easily and quickly locate the material accurately in the machine prior to cutting. (4 marks) Any other suitable response.

Question			Expected response	Max mark	Additional guidance
	(c)		The candidate is expected to describe any four aspects between the two scooters in relation to aesthetics.	**4**	Four descriptions at 1 mark each. **(Candidates must refer to Four different aspects)** **Aesthetic appeal is likely to be described in terms of:** • Shape • Line • Form • Proportion • Pattern • Light • Texture • Colour • Fashion • Style/brand • Contrast • Harmony • Balance/Symmetry • Market trends **eg** The wooden scooter is **neutral in colour which makes it suitable for a wider market.** (1 mark) The aluminium scooter has a good **contrast of colour to the natural metal and a sleek form which makes it look very sporty**. (2 marks) The natural wood, red and black used for the wooden scooter gives a very traditional look compared to the futuristic look of the 'kick' scooter (1 mark) Any other suitable description.

Question			Expected response	Max mark	Additional guidance
	(d)		The candidate is expected to describe any four different environmental considerations relating to the design, manufacturer and use of these scooters.	4	Four areas described at 1 mark each. **Skate scooter:** • Use of plywood instead of natural wood, means less use of natural sources • More products can be transported at one time due to being flat, reducing pollution from transportation • Due to being in sections individual parts can be replaced reducing the amount of waste and increasing the life of the toy • Forest management issues (sustainability) **Kick scooter:** • Aluminium is a natural material which has to be mined • Scooter can be split into sections for ease of recycling/re-use • Durable materials/assembly to last longer • Adjustable handlebar allows the scooter to grow with the user. **Both scooters:** • Waste produced from manufacturing methods • Pollution produced from manufacturing methods • Use of standard components meaning maintenance can be carried out to prolong the life of the product • Aluminium was used because it can be easily recycled (1 mark) **It should be noted that candidates responses may refer to the environment where the product is used. Marks should be awarded accordingly.** • Easy to clean • Easy to store/transport • Indoor/Outdoor use Any other suitable description

Question			Expected response	Max mark	Additional guidance
	(e)		The candidate is expected to describe any five functional aspects of the two scooters.	**5**	Five descriptions at 1 mark each. A maximum of four marks per scooter. **Functional aspects are likely to be described in terms of:** • Easily folded for portability (Kick scooter only) • Easily folded for storage (Kick scooter only) • Easily steered/manoeuvred • Can support the weight of the user group • Simply designed for ease of use • Ease of self-assembly • Handles provide grip • Adjustability of handle height (Kick scooter only) • Resistant to knocks • Lightweight for child to carry on their own • Easy maintenance • 3 wheels for balance • Functional aspect that refer to safety **eg** The aluminium scooter has an **adjustable stem, which makes it suitable for use by children of different heights**. This means it could be passed down from child to child. It can also be **folded up to allow it to be stored away neatly avoiding mess in the home**. (2 marks) The simple design allows the traditional scooter to be easily cleaned. (1 mark)

Section 2

Question			Expected response	Max mark	Additional guidance
2.	(a)		The candidate is expected to give **two** explanations why this type of material is suitable for the product. The candidate may name a thermo-setting plastic in their response eg melamine formaldehyde or urea formaldehyde, but this does not attract any marks.	**2**	**One** mark for each appropriate explanation. **Responses are likely to include:** • High impact strength • Scratch resistance • Heat resistance • Chemical/stain resistance • Tasteless/odourless • Durable • Ease of cleaning • Range of colours available Any other suitable answer **eg** Thermo-setting plastic is a suitable material because of its high impact strength. Meaning it will not break if it is dropped. (1 mark) A thermo-setting plastic is suitable to use for the utensils as it has a high resistance to heat and is scratch resistant. Meaning it will not warp if in contact with hot food won't scratch when used with metal pots and pans. (2 marks)

Question			Expected response	Max mark	Additional guidance
	(b)		The candidate is expected to describe **three** techniques that would be used to identify the needs of the user group. **No marks awarded for naming of technique.**	**3**	**One** mark for each valid description of technique. (1+1+1) Responses are likely to include the following: • Focus groups • Questionnaires/Surveys • Analysis/User trial of existing products • Analysis of current market trends Any other suitable technique **eg** A group of adults of various ages could be gathered together as a focus group and asked to explain for what purpose or how they would use a set of products of this type. (1 mark) An analysis of the current market by looking on the internet or in shops would give an idea of the various uses of these types of product. (1 mark)

Question			Expected response	Max mark	Additional guidance
	(c)		The candidate is expected to describe at least **two** methods of presentation of a design proposal to a client. No marks awarded for naming presentation methods.	**4**	**One** mark for each appropriate description. **A maximum of 3 marks per presentation method.** Responses are likely to be drawn from the following methods: • Presentation drawings • Computer modelling • Models • Prototypes • Power point presentation (with clear description of how proposal is communicated) Any other suitable method **eg** A designer could produce a set of presentation drawings to show the client the proposals for his design. (1 marks) A computer presentation could be shown to the client to convey the proposal using a rendered 3D image or a model could be produced to provide the client with a clear idea of proportion (2 marks)

Question			Expected response	Max mark	Additional guidance
3.	(a)		The candidate is expected to explain **two** benefits gained from using this process.	**2**	**One** mark for each valid explanation. No marks for Mass production. **Responses are likely to include:** • Fast production rates/economically viable • Material flexibility • Product diversification (interchangeable moulds) • Large volume production • Accuracy • Repeatability • No further finishing required • Low waste • Semi-skilled workforce • Reduced labour costs Any other suitable answer **eg** This process guarantees the manufacturer accuracy of component. (1 mark) Fast production rates allows for a large volume of products to be manufactured each day. (1 mark)

Question			Expected response	Max mark	Additional guidance
	(b)		The candidate is expected to explain the impact that this process has on society.	**4**	**One** mark for each valid explanation. *No marks awarded for a repeat answer from section (a) eg semi-skilled work force.* **Response are likely to include:** • Reduced work force • Changed need for skilled workforce • De-skilling of work force/reduced training costs • Changed work patterns • Mass consumerism • Population migration • Environmental impact Any other suitable answer **eg** Manufacturing products using a fully automated process such as injection moulding means that these products can be produced at a lower cost so more people in society can afford them thereby improving their quality of life. (1 mark) Automation creates a reduction in the work force and therefore may cause unemployment issues (1 mark) within society and this may result in people moving to other areas to find work. (1 mark)

Question			Expected response	Max mark	Additional guidance
4.	(a)		The candidate is expected to explain the suitability of the processes for the manufacture of the shelving system.	**3**	**One** mark for each valid explanation. *Mention of mass production - 0 marks* **Responses are likely to draw from the following characteristics of the processes:** • Material in thin sections • Material suited to process (malleable/ductile) • Accuracy of sizes • Repeatability • Consistency in quality • No further finishing • Increased strength of component after pressing • Economical process (explained) Any other suitable answer **eg** Piercing is used in the manufacture of the uprights of the shelving unit as it creates very accurate holes. (1 mark) Blanking is used to produce the shelves because the material is very thin and this suits the process (1 mark) and the shape created will be the same each time. (1 mark) The basic shape of the shelves is produced by blanking as it does not require any further finishing, (1 mark) the holes in the shelves are pierced as this process is very accurate (1 mark) then pressing is used to create the final shape because the metal is thin and easily bent. (1 mark)

Question			Expected response	Max mark	Additional guidance
	(b)		The candidate is expected to explain the appropriateness of the assembly technique.	**3**	**One** mark for each valid explanation. **Responses are likely to include:** • Ease of replacement/repair • Non-permanent fixings allow for disassembly • Quality issues • Assembly costs cheaper than other methods (eg Welding/Riveting) • Self-assembly using basic tooling • No specialist skills required • Flexibility of configuration Any other suitable answer **eg** Nuts and bolts can be easily replaced if lost or broken. (1 mark) Saves the manufacturer time and money as they do not need to assemble the shelving unit. (1 mark) Nuts and bolts allow for the shelving unit to be assembled and taken apart easily (1 mark) using simple tools such as a spanner. (1 mark) Using this technique allows for flexibility in the configuration of the shelves. (1 mark) You can assemble and dismantle the unit by yourself using readily available tools such as a spanner. (1 mark)

Question			Expected response	Max mark	Additional guidance
	(c)		The candidate is expected to explain **two** drawbacks of using standard components.	**2**	**One** mark for each valid explanation. No marks awarded for repeat answers from 4b. **Responses are likely to include:** • Delivery issues • Costs • Dealing with third-party, eg contracts, relationships, stability of supplier • Quality assurance • Sustainability issues • Restrictions in design Any other suitable answer **eg** A drawback for the manufacturer of using standard components is that when they are bought in from another company they do not have direct control over quality. (1 mark)

Question			Expected response	Max mark	Additional guidance
5.			The candidate is expected to describe the role of **three** of the members of a design team from the list shown: • Accountants • Lawyers • Materials technologists • Production specialists • Market researchers • Retailers	**6**	**One** mark for each valid description. *Marks can only be allocated to a maximum of **three** team members* *A maximum of **three** marks for any design team member (3+2+1) or (2+2+2)* **eg** An **Accountant** would be responsible for overseeing all the costs related to the design and manufacture of the product (1 mark). He would be responsible for managing the profit and losses. He would liaise directly with the client during the process. (1 mark) A **Lawyer** is responsible for any legal matters that may arise during the production of the product such as applying for patents/trademarks etc (1 mark) The **Material Technologist** provides advice on the selection of suitable materials for manufacture of the product depending on the target market. (1 mark) They work closely with production specialists to ensure that any materials selected are suited to the methods of production available. (1 mark) **Production Specialists** provide advice on production planning and tooling for manufacture (1mark). They liaise with engineers and material technologists to ensure that the product is produced as efficiently as possible. (1 mark) The **Market Researcher** will work with focus groups to find out their needs/wants potential prices for the product. (1 mark) **A Retailer** sells the product and is in a position to liaise with the marketing teams and supply feedback information on sales figures and market trends. (1 mark)

Question			Expected response	Max mark	Additional guidance
6.	(a)		The candidate is expected to explain the benefits gained from using these types of techniques to generate ideas. No marks awarded for naming the idea generation technique in the response.	**3**	**Explanations are likely to include:** • Creative thinking • Diverse thinking • Working as part of a group • Encourages spontaneity of response • Originality of thought • Provides a starting point • Overcomes mental block • Re-use ideas in a new way • Generate ideas to suit a particular target market • Can provide structure Any other suitable answer **eg** Using thought showers gives a designer the opportunity to work as part of a group and exchange ideas (1 mark) to generate ideas for solving problems by stimulating creative thinking by participation in discussion. (1 mark)

Question			Expected response	Max mark	Additional guidance
	(b)		The candidate is expected to select **two** modelling techniques from the following: • Scale models • Mock-ups • Fully crafted prototypes • Test models • Computer generated models • Part product models • Simulations • Rapid prototyping	**5**	**No** mark for Identification of modelling technique. *Marks can only be allocated to a maximum of **two model types*** *A maximum of **four** marks for any model type (4 +1) or (3+2)* **eg** Scale Models allow the designer to gather information for the design such as appropriate sizes (1 mark) and to check the assembly methods of different components. (1 mark) Responses are likely to include information relating to the following aspects: • Ergonomics • Aesthetics • Functional requirements • Performance • Marketing • Safety • Assembly information • To communicate with the client Any other acceptable answer

Question			Expected response	Max mark	Additional guidance
7.			This question is set to test the candidate's ability to present a reasoned discussion about design knowledge. 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**	Explanations are likely to make reference to some of the aspects below: **Anthropometrics; comments relevant to how the sizes of the product(s) have been influenced by sizes of specific parts of the body:** • widths • lengths • heights • adjustability • grips • reach **Physiology; comments relevant to how the parts of the product(s) have been influenced by limitations of specific parts of the body:** • weights • strengths • comfort • strain • pressures applied/required • rotation • forces • limitations relevant to age • limitations relevant to dexterity **Psychology; comments relevant to how parts of the product(s) have been influenced by the senses of the body:** • smells • sounds • tastes • feels • looks Whilst the response can include these aspects, it should be noted that the candidate may include others depending on the product(s) referenced.

0-2 marks	3-4 marks	5-6 marks	7-8 marks
An answer which falls into this category may do so for a number of reasons. • **Limited** knowledge of the subject matter and an understanding of anthropometrics, physiology **or** psychology will be 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.	An answer which falls into this category may do so for a number of reasons. • **Adequate** knowledge of the subject matter and an understanding of anthropometrics, physiology **or** psychology will be demonstrated. **Minimum of two** • The answer will be relevant to the question. • Limited reference is made to products. • Although examples are used, points made are unclear	An answer which falls into this category may do so for a number of reasons. • **Secure** knowledge of the subject matter and an understanding of anthropometrics, physiology **and** psychology will be demonstrated. • The answer will be relevant to the question demonstrating a good level of comprehension • Detailed reference is made to at least one product. • Most points made are clear and examples are used to support them.	An answer which falls into this category may do so for a number of reasons. • **Extensive** knowledge of the subject matter and a secure understanding of anthropometrics, physiology **and** psychology will be demonstrated. • The answer will be relevant to the question demonstrating a high level of comprehension. • Very detailed reference to at least one product. • All points made are clear and examples are used to support them.

[END OF MARKING INSTRUCTIONS]