National
Qualifications
RESOURCE

X819/76/11 Design and Manufacture

Marking Instructions

Please note that these marking instructions have not been standardised based on candidate responses. You may therefore need to agree within your centre how to consistently mark an item if a candidate response is not covered by the marking instructions.

General marking principles for 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) The term 'or any other valid response' allows for possible variation in candidates' responses. Always award marks according to the accuracy and relevance of an answer.

(d) 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.

(e) 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.

(f) Where a question asks candidates to **discuss**, they must communicate ideas and information on a subject. It may be possible to debate two sides of the statement.

Marking instructions for each question

Section 1

Question			Expected response	Max mark	Additional guidance
1.	(a)		Candidates are expected to explain why the materials chosen are suitable for these parts. Candidates should give six different explanations. Candidates explanations should relate to the materials chosen for the barbecues and/or their component parts. They should include the properties or benefits of the materials related to this product.	**6**	**Six** valid explanations at **1 mark** each. **No marks** awarded for simply stating properties. **No marks** awarded for repetition of explanations. **Mild steel body and lid** • corrosion resistant (when painted) • good strength to weight ratio • ductile/malleable • resistant to heat. **Chrome plated tubular mild steel frame** • durable (chrome plating resists corrosion) • tubular steel reduces weight • tubular form saves on material • can be welded. **ABS wheels** • good chemical resistance (easily cleaned) • durable (can be used outdoors without deterioration) • good strength/rigidity to withstand the weight of the barbecue • scratch resistant (maintains aesthetic look) • impact resistant. **Melamine formaldehyde handle** • heat resistant • good chemical resistance (easily cleaned) • hard wearing (durable).

Question			Expected response	Max mark	Additional guidance
					Stainless steel grill • corrosion resistant • tough • durable • aesthetic qualities • hygienic (easy to clean). **Stained beech trolley frame** • aesthetic qualities • strength, to support the weight of the barbecue • resistance to warping/straight grain • workability • easy to clean/wipe down • durability. **Cast iron main grill** • conducts/disperses heat for cooking • hard wearing (durable). Any other suitable explanation.

Question			Expected response	Max mark	Additional guidance
	(b)		Candidates are expected to name three appropriate manufacturing processes used in the production of these barbecues and explain why each one is suitable.	**6**	**Three** appropriate mass manufacturing processes and their suitability explained. Maximum of **3 marks** for naming of processes (**1 mark** for each process). Maximum of **3 marks** for explanations of suitability. **1 mark** for each explanation of suitability, where more than **one** explanation is given to a process, **a maximum of 2 marks** per process should be awarded. **NB** Marks can be awarded for correct explanation of an incorrect process. *The ABS wheels have been vacuum formed (**0 marks**, incorrect process) as it produces the intricate detail. (**1 mark**, correct justification for injection moulding)* **Processes could include** **Kettle barbecue** • extrusion of tubular mild steel to provide continuous cross section • press forming for body/lid • piercing to provide holes for attachment of handle etc • blanking of component parts (frame shelf) • injection moulding of wheels • compression moulding of handle • welding of frame parts • chrome plating • painting of mild steel (spray painting). **3 burner gas barbecue** • press forming for body/lid • piercing to provide holes for attachment of handle etc • blanking of component parts • injection moulding for ABS wheels • sand casting for cast iron main grill • welding for warming rack.

Question			Expected response	Max mark	Additional guidance
					Wooden frame • use of templates/jigs to ensure consistency in size and accuracy of component 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, accuracy • drilling creates accurate holes for fittings – linked with JIGS • knockdown fittings reference to standard components; benefits to manufacturer/consumer • staining for finishing. **Explanations could include** • repeatability of process • accuracy of process • economies of scale (mass/batch) • shape/form is suitable for process • surface finish/no further finishing required • uniform cross section for extrusion • intricate detail • suitability of process to material • strength achieved through welding/press forming • thin sheet (suitable for piercing and blanking). Any other suitable explanation.

Question			Expected response	Max mark	Additional guidance
	(c)		The candidate is expected to describe how aesthetics has influenced the design of these barbecues.	**4**	**Four** appropriate comments at **1 mark** each. Candidates must refer to **four different** aesthetics aspects. Responses should be based on the aesthetic facts relating to the barbeques. **Aesthetics are likely to be examined in terms of** • shape • line • form • proportion • pattern • light • texture • colour • fashion • style/brand • contrast • harmony • balance/symmetry • market trends • aesthetics for function • suitability for target market. Any other suitable description. *For example, in the round kettle charcoal barbeque there is a contrast in colour between the orange of the body and chrome plated frame **(1 mark)**, there is also a contrast of style in the 3 burner gas barbeque between the modern stainless housing and the traditional beech frame. **(1 mark)*****

Question			Expected response	Max mark	Additional guidance
	(d)		Candidates are expected to explain the benefits of using computer aided design in the manufacture of products such as these barbecues.	**4**	**Four** explanations at **1 mark** each. **Explanations are likely to include** • carrying out testing such as stress analysis • easier to communicate manufacturing information with other members of the design team (collaborative working) • easily sent for rapid prototyping • production drawings easily created • assisted production planning • parts lists easily created • transferred to CNC machinery/quicker route to manufacture. Any other suitable explanation.

Question			Expected response	Max mark	Additional guidance
	(e)		Candidates are expected to describe how the following have influenced the design of the barbecues • function • safety. To attract full marks, candidates must reference both function and safety in their answer.	**5**	**Five** appropriate descriptions at **1 mark** each. A **maximum of 4 marks** can be awarded for any single design factor **(4 + 1)**. **Descriptions are likely to include** **Function** • withstand continual/repeated use (durability) • wheels make the barbeques easily portable/mobile • easily cleaned • easily assembled (kettle barbecue only) • foldable side shelf provides space for plates etc (gas barbecue only) • ease of use – weight of lift off lid (kettle barbecue) • ease of use – hinged lid (gas barbecue) • storage rack allows space for storing accessories • warming rack allows food to be kept warm • electronic ignition allows easier lighting • ease of maintenance (changing gas bottle, cleaning out used charcoal) • dials used to adjust heat (gas barbecue). **Safety** • heat resistance of handles prevents burning • stability when in use • non-wheeled leg to prevent rolling • hygienic materials (stainless steel) • lid opening/closing (finger traps) • gas regulator provides safe gas flow • complies with relevant British or CE standards • appropriate safety instructions supplied with barbecues • temperature gauge. Any other suitable descriptions.

Section 2

Question			Expected response	Max mark	Additional guidance
2.	(a)		Candidates are expected to identify a suitable metal that could be used for the trucks of the skateboard and explain why it is appropriate.	**3**	**Maximum 1 mark** for identification of a suitable metal. **Responses are likely to include** **Material selection** • steel • brass • aluminum. **Explanations are likely to include** (only if appropriate to metal given) • corrosion resistance • easy to cast • low melting point • strength to weight ratio • lightweight (if explained) Any other suitable answer.

Question			Expected response	Max mark	Additional guidance
	(b)		Candidates are expected to identify a suitable process for the manufacture of the trucks of the skateboard and explain why it is appropriate.	3	**Maximum 1 mark** for identification of process. **Responses are likely to include** **Process selection** • die casting • sand casting. **Explanations likely to include** • high dimensional accuracy (die casting) • high quality surface finish (die casting) • complex shapes • surface details (logos, text) • economy of scale (die casting) • speed of production (die casting) • low cost tooling (sand casting) • repeatability. Any other suitable answer.

Question			Expected response	Max mark	Additional guidance
	(c)		Candidates are expected to explain the benefits plastic composite materials have over plywood.	**2**	**Two** valid explanations at **1 mark** each. Marks awarded must be in relation to benefits of using plastic composite materials over plywood. **Explanations are likely to include** • reduced weight • increased strength • resistance to rot • dimensional stability • resistance to wear (durability) • no need to apply a finish • aesthetics (customisable). Any other suitable explanation.

Question			Expected response	Max mark	Additional guidance
3.			Candidates are expected to describe how ergonomics has influenced the design of these vacuum cleaners. To attract full marks, candidates must cover all **three** areas of ergonomics in their answer.	**6**	**Six** appropriate descriptions at **1 mark** each. All **three areas** of ergonomics must be addressed to gain **full marks.** Award a **maximum of 5 marks** if a candidate refers to only two areas. A **maximum of 3 marks** can be awarded for any single area **(3+2+1 or 2+2+2)** up to a **maximum of 6 total marks**. Candidates **must** relate anthropometrics to part of the body. **Do not** accept generic body parts for example hand sizes, without clear description. **Descriptions are likely to include** **Anthropometrics** (Ignore incorrect percentile range, if given). • grip sizes • finger width to use buttons • finger length to operate buttons whilst holding handle • handle length • finger/hand thickness for clearance in handles • adjustable extension pole • height of handle (vacuum cleaner C). **Psychology** • use of colour to denote function • button layout • shape for intuitive use • ease of use • vibration feedback • lights showing vacuum is on • motor noise • transparent to show when full.

Question			Expected response	Max mark	Additional guidance
					Physiology • lightweight (lifting, carrying, fatigue) • force required to change attachments/push buttons • wheels to make moving easier (vacuum A & C only) • comfortable handles • ease of adjustment • posture. Any other suitable description.

Question			Expected response	Max mark	Additional guidance
4.	(a)	(i)	Candidates are expected to describe the role of material technologists in the development of products.	**2**	**Two** valid descriptions at **1 mark** each. **2 marks** may be awarded for an extended description. **Descriptions are likely to include** • has knowledge of materials and their properties • offers advice to the designer about the materials which would be best suited to the job • takes into consideration their cost, availability, etc • works closely with other specialists to ensure that any materials selected are suited to the methods of production available • has knowledge of new and emerging materials. Any other suitable description.

Question			Expected response	Max mark	Additional guidance
		(ii)	Candidates are expected to describe the role of market researchers in the development of products.	**2**	**Two** valid descriptions at **1 mark** each. **2 marks** may be awarded for an extended description. **Descriptions are likely to include** • carries out research on what consumers' wants/needs are • compiles findings and presents to the designer • will carry out surveys, questionnaires, user trials etc • investigating market activity/assessing future trends • analysing published data and statistics • evaluating past performance of a product or service's sales • coordinating research projects. Any other suitable description.
	(b)		Candidates are expected to explain why a designer may prefer an open design brief.	**2**	**Two** valid explanations at **1 mark** each. **2 marks** may be awarded for an extended explanation. **Explanations are likely to include** • less restrictions than a closed brief • an open brief would give the designer more creative freedom • an open brief would enable the possibility of more innovative ideas • more opportunity to diversify into new, related product ideas. Any other suitable explanation.

Question			Expected response	Max mark	Additional guidance
	(c)		Candidate are expected to explain the benefits of using idea generation techniques during the design process.	**2**	**Two** valid explanations at **1 mark** each. **2 marks** may be awarded for an extended explanation. **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 • can provide structure. Any other suitable explanations.

Question			Expected response	Max mark	Additional guidance
	(d)		Candidates are expected to describe how **two** different types of physical models could be used to advance the design of a product.	**4**	**Four** valid descriptions at **1 mark** each. A **maximum of 3 marks** can be awarded for any single model type. **(3+1)** **No marks** should be awarded for simply naming model types. **No marks** should be awarded for descriptions relating to computer generated models. **Descriptions are likely to include** **Sketch models** • used during idea generation • can be used to develop/explore ideas • helps communicate ideas that are difficult to draw • check product size/proportion. **Block models** • used to communicate form, dimensions or surface details • can be used to test ergonomics • can be presented to clients • can be used for advertising/user feedback. **Prototypes** • can be used for functional testing • check for any final changes before production • check parts can be assembled as intended. **Scale models** • gather information on appropriate sizes • check the overall proportion • test ergonomics • check assembly methods. Any other suitable description. *For example, a miniature model allows you to check the proportion using an ergonome. (**1 mark**, incorrect model type but correct description for a scale model)*

Question			Expected response	Max mark	Additional guidance
5.	(a)		Candidates are expected to describe how each of these factors have influenced products with which they are familiar.	**4**	**Four** valid descriptions at **1 mark** each. A **maximum of 3 marks** can be awarded for each factor. **(3+1)** **Descriptions are likely to include** **Technology push** • wireless charging • increased durability • flexible/curved screens • augmented reality • touch screen technology • 3D graphics ability • miniaturisation • wi-fi capability • improving audio technology • improvements in graphics/video technology • increased memory capability • 'cloud' storage. **Market pull** • mobile payments • need for accessibility • affordability • portability • improved quality (of product) • online features • compatibility with existing products/previous version(s) of products • health and fitness tracking • aesthetics — colour/style options. Any other suitable description.

Question			Expected response	Max mark	Additional guidance
	(b)		Candidates are expected to describe the impact planned obsolescence may have on the consumer.	**2**	**Two** valid descriptions at **1 mark** each. **2 marks** may be awarded for an extended description. **Descriptions are likely to include** • changes in fashion/style • no longer supported by manufacturer (software upgrades) • encourages 'throw away' society • unable to be repaired or maintained by user • technology slowing down/lagging. Any other suitable description.
	(c)		Candidates are expected to describe the **economic** benefits of a strong brand image.	**2**	**Two** valid description at **1 mark** each. **2 marks** may be awarded for an extended description. **Descriptions are likely to include** • providing a platform for growth • lower cost of promotion/advertising (brand promoted through word of mouth) • the brand can command a higher selling price • higher market share/consumer loyalty (increased turnover) • higher stature (through consumer perception of quality)/consumer loyalty Any other suitable description.

Question			Expected response	Max mark	Additional guidance
	(d)		Candidates are expected to describe the steps that a company could take to delay this decline.	**3**	**Three** valid descriptions at **1 mark** each. **Descriptions are likely to include** • increase advertising • reduce price • special offers (for example gifts, bundles) • updated versions (software) • special editions/additional features • rebranding. Any other suitable description.

Question			Expected response	Max mark	Additional guidance
6.	(a)		Candidates are expected to describe two ways that the materials used in the glue gun could be identified.	**2**	**Two** valid descriptions at **1 mark** each. **No marks** for simply stating a method. **Descriptions are likely to include** • flame tests (may include flame colour or fume smell) • comparison to other materials • aesthetic aspects • density/float tests • scratch tests • drop tests • visual examination of surface finishes • magnetism • identification symbols on plastic parts. Any other suitable description. *For example, you could find out what the material is by burning it.* ***(0 marks)*** *You could tell the difference between melamine formaldehyde and urea formaldehyde by burning them as they would give off a different smell.* ***(1 mark)*** *You could look at the aesthetics of the material for example its colour and texture.* ***(1 mark)***

Question			Expected response	Max mark	Additional guidance
	(b)		Candidates are expected to describe how the features created during injection moulding aid assembly.	4	**Four** valid descriptions at **1 mark** each. **2 marks** may be awarded for an extended description. **No marks** should be awarded for simply stating the name of a feature to aid assembly. **Descriptions are likely to include** • bosses (incorporates a space for a thread/bolt/screw for assembly) • location pins (used to ensure the accurate positioning of a workpiece) • ribs (allows for location of internal components) • symmetrical and asymmetrical parts • labelling • moulded threads. Any other suitable description.

Question			Expected response	Max mark	Additional guidance
	(c)		Candidates are expected to describe how production and planning systems could be used to improve efficiency during manufacture of products such as the glue gun.	4	**Four** valid descriptions at **1 mark** each. **No marks** should be awarded for naming of production and planning systems. **Descriptions are likely to include** **Production methods** • one-off production (prototypes) • batch production • mass production • use of jigs/fixtures • use of patterns • use of standard components • CAD/CAM • CNC machining (automation) • rapid prototyping • JIT • sub-contracting • quality control. **Planning systems** • Gantt charts • flow charts or any other sequence planning method.

Question			Expected response	Max mark	Additional guidance
					Descriptions should relate to improvements in efficiency by • reducing lead-time • reducing purchase inventory/storage of component parts • reducing delays in purchasing of components • maximising output/less hours lost in production time • maximising workforce/labour requirements • maximising efficient use of plant machinery • structured planning of production (JIT) • increase in quality assurance and control of production • increase in productivity • reducing stock wastage • reducing manufacturing costs. Any other suitable description.

Question			Expected response	Max mark	Additional guidance
7.			Candidates are expected to describe how consideration for the environment has influenced the **design, manufacture, use** and **disposal** of products. This question is set to test the candidate's ability to present a reasoned discussion about how designers consider environmental issues at all stages of a product's life. 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** **Design** • efficient/innovative use of materials • use of 'green' materials • design for rethink, refuse, reduce, reuse, repair, recycle • circular economy • obsolescence • minimise packaging • using recyclable materials • labelling of plastic components to assist recycling • use of recycled materials in the design of the product • easily dismantled products • reduce number of materials used • incorporate components that could be reused **Manufacture** • efficient/innovative use of materials • use of 'green' materials • transportation issues (manufacture close to point of sale) • easily transported (lightweight/stackable) • waste management (minimise waste) • minimise packaging • efficient/innsovative use of production and planning • using recyclable materials • labelling of plastic components to assist recycling • use of recycled materials in the manufacture of the product • efficient/innovative use of manufacturing processes/machinery • reduced volume of material used in each product • reduce number of manufacturing processes used

Question			Expected response	Max mark	Additional guidance
					Use • sustainability • circular economy • obsolescence • easily dismantled products for maintenance • easily transported (lightweight/stackable) • reuse components • efficient in use ('A' rated products) • use of durable materials to increase lifespan of product. **Disposal** • use of 'green' materials • sustainability • up-cycling • obsolescence • waste management (minimise waste) • recyclable packaging • using recyclable materials • labelling of plastic components to assist recycling • easily dismantled products • reuse components. Candidate should relate the points above to how they impact stages in a products life from design to disposal. To achieve marks in the secure banding or above candidates must refer to at **least three stages.**

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 or understanding of environmental issues • very few points are made • much of the response does not answer the question • the answer is simply too thin • limited reference is made to stages in a product's life.	An answer which falls into this category may do so for a number of reasons. • **adequate** knowledge or understanding of environmental issues • the answer will be relevant to the question • some reference is made to stages in a product's life • 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 or understanding of environmental issues • the answer will be relevant to the question and demonstrate a good level of comprehension • reference is made to three or more stages in a product's life • 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 or understanding of environmental issues • the answer will be relevant to the question, demonstrating a high level of comprehension • clear connections are given between environmental aspects and multiple stages in a product's life • all points made are clear and examples are used to support them.

[END OF MARKING INSTRUCTIONS]