National
Qualifications
2024

2024 Design and Manufacture

Higher

Question Paper Finalised Marking Instructions

These marking instructions have been prepared by examination teams for use by SQA appointed markers when marking external course assessments.

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 the sun loungers. Candidates' explanations should relate to the materials chosen for the sun loungers and/or their component parts. **Explanations are likely to include:** **Luxury sun lounger** **Mahogany:** • aesthetic qualities • strength, to support the weight of the user • resistance to warping/straight grain • workability • durability. **ABS Tyres:** • good chemical resistance (easily cleaned) • durable (suitable for multi terrain) • scratch resistant (maintains aesthetic look) • impact resistant (withstand knocks and bumps). **Stainless steel nuts/bolts** • corrosion resistant • strength, to maintain the structure of the lounger • aesthetic qualities.	**6**	**Six** valid explanations at **1 mark** each. Candidates should give **six** different explanations. Candidates' explanations should relate to the materials chosen for the sun loungers and/or their component parts. Responses should include the properties of the materials chosen in relation to these products. **No marks** awarded for simply stating properties. **No marks** awarded for repetition of explanations. Exemplar response: *Mahogany is suitable for the frame as it is durable allowing the sun lounger to be used without breaking.* ***(0 marks)*** *Polypropylene is tough meaning it can withstand impact. (****1 mark)*** *Polypropylene is used for the corner protectors because it is easy to clean.* ***(0 marks)*** *Tubular aluminium frame has a good strength to weight ratio meaning it is light enough for users to lift it and move it* ***(1 mark)*** *but strong enough to hold the weight of the user* ***(1 mark)****.*

Question			Expected response	Max mark	Additional guidance
			Folding sun lounger **Tubular aluminium frame:** • durable • corrosion resistant • good strength to weight ratio (if explained) • tubular saves on material • lightweight (portable) • strength, to support the weight of the user • ductile/malleable. **Aluminium brackets:** • corrosion resistant • ductile/malleable for press forming. **Polypropylene corner protectors/footpads:** • good chemical resistance (easily cleaned) • durable (wear and tear) • scratch resistant (maintains aesthetic look) • impact resistant • aesthetic qualities (available in choice of colours). **Nylon netting:** • good chemical resistance (easily cleaned) • durable (can be used outdoors without deterioration) • strength to resist ripping/tearing while supports user weight • soft texture provides comfort • flexible (moulds to body shape) • aesthetic qualities (available in choice of colours). **Any other valid explanation.**		

Question			Expected response	Max mark	Additional guidance
	(b)		Candidates are expected to name **three** appropriate manufacturing processes used in the production of the sun loungers **and** explain why each one is suitable. **Explanations are likely to include:** **Wooden sun lounger:** • use of templates/jigs: ensure consistency in size and accuracy of component parts. Reduces time of repetitive tasks • CNC machining (routering): to cut shaped sections (must make reference to CNC) clean finish, multiple sections of same shape cut together, accuracy • steam bending (arm rests) • Injection moulding of ABS tyre • die casting – standard components • drilling: creates accurate holes for fittings – linked with JIGS • modern manufacture/knockdown fittings: reference to standard components; benefits to manufacturer/consumer • staining for finishing. **Folding sun lounger:** • extrusion of tubular aluminium frame • bending tubular frame • Blanking of aluminium leg brackets • press forming of aluminium leg brackets • piercing to provide holes for assembly • drilling • injection moulding of foot pads and corner protectors • riveting of legs to brackets • woven nylon netting, machine stitched to prevent fraying.	**6**	Any **three** appropriate mass manufacturing processes and their relationships regarding suitability explained. **A maximum of 3 marks** for naming of processes, where related to part of the product (**1 mark** each process). **A 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 for the feature produced if an incorrect process is given. Exemplar response: *The ABS foot pads have been vacuum formed **(0 marks)** as it produces the complex shape. (**1 mark**)* *Extrusion is used for the aluminium frame **(1 mark)** as it has a continuous cross section **(1 mark)** and is very accurate. **(1 mark)***

Question			Expected response	Max mark	Additional guidance
			Justification statements 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 • complexity of shape (injection moulding) • suitability of process to material • sheet aluminium suitable for press forming /blanking/piercing • strength created through forming sheet aluminium • riveting provides semi-permanent join, provides hinging mechanism. **Any other valid explanation.**		

Question			Expected response	Max mark	Additional guidance
	(c)		Candidates are expected to describe how function has influenced the design of the sun loungers. **Descriptions are likely to include:** **Wooden sun lounger:** • wheels allow easy movement • textured ABS tyres provide grip on wheels • non-wheeled legs prevent rolling when in use • multi position back/leg rest for comfort • addition of armrests for comfort • strength of construction (appropriate materials/assembly) • slated design allows air circulation • use of standard components allows easy maintenance • self-assembled (flat pack/disassemble) • width of legs provide stability. **Folding sun lounger:** • foldable for storage/portability • weight allows easy lifting for portability • removable pillow for comfort • use of standard components allows easy maintenance • material appropriate for outdoor use, water resistant • multi position backrest for comfort • strength of construction (appropriate materials/assembly) • Polypropylene footpads provide additional grip • breathable netting allows air circulation • netting provides comfort (soft texture, elasticity moulds to body shape). **Any other valid description.**	**5**	**Five** appropriate descriptions at **1 mark** each. Exemplar response: *Function has influenced the folding sun lounger as its primary function is to have people lay on it and catch some sun **(0 marks)**. The secondary function is to have it fold making it more portable. **(1 mark)***

Question			Expected response	Max mark	Additional guidance
	(d)		Candidates are expected to describe how anthropometrics and physiology have influenced the design of the sun loungers. **Descriptions are likely to include:** **Anthropometrics:** • sitting height above ground to popliteal height • width of sun lounger to width of shoulders • length of sun lounger back to length of user back • distance to knee fold position to length of upper leg • length of armrest to length of forearm • width of armrest to width of arm • overall length of sun lounger when flat to full body length/height • diameter/thickness of frame to users grip diameter for lifting. **Physiology:** • force required to fold/unfold portable sun lounger • posture issues (adjustability of backrest) prevent strain • posture issues (position of head support) prevent strain • limitations of dexterity • strength/force required to lift/push sun lounger (free rolling wheels) • strength required to carry portable sun lounger. **Any other valid description.**	**4**	**Four** appropriate descriptions at **1 mark** each. The candidate must make reference to both anthropometrics and physiology to achieve full marks. **A maximum of 3 marks** for any single area **(3+1).** Candidate descriptions **must** relate to its appropriate area of ergonomics. Candidates **must** relate specific anthropometric data to the specific part of the products. *(Ignore incorrect percentile range, if given).* Exemplar responses: *The arm rest must fit the arm length.* ***(0 marks)*** *The length of the sun lounger must be suitable for the height of the user.* ***(1 mark)*** *The portable sun lounger must be light enough to move.* ***(0 marks)*** *The portable sun lounger must be light enough to move without causing strain to the user.* ***(1 mark)***

Question			Expected response	Max mark	Additional guidance
	(e)		Candidates are expected to explain the benefits of using computer aided design (CAD) during the design of the sun loungers. **Explanations are likely to include:** • easier to alter the design • library of parts • carrying out testing such as stress analysis • aesthetic checks • easily rendered to provide visuals/animations for clients • easier to communicate design information with other members of the design team (collaborative working) • easily sent for rapid prototyping • reduced cost of physical modelling (explained) • reduces material waste. **Any other valid explanation.**	**4**	**Four** appropriate explanations at **1 mark** each. Exemplar response: *CAD is compatible with CAM/CNC so can be sent directly to the manufacturer.* ***(0 marks)*** *CAD can be used to test different colours and materials easily* ***(1 mark)*** *making sure you don't waste material.* ***(1 mark)***

Section 2

Question			Expected response	Max mark	Additional guidance
2.	(a)		Candidates are expected to explain why rotational moulding is a suitable process for these parts of the children's play frame. **Responses are likely to include:** • one piece construction • large products can be made • hollow/lightweight parts • relatively low tooling costs • uniform wall thickness • good quality surface finish (not high quality). **Any other valid explanation.**	**2**	**1 mark** for each valid explanation. Up to **a maximum of 2 marks.** Exemplar response: *Rotational moulding is suitable as it produces a hollow product **(1 mark)** with a high-quality finish. **(0 marks)***
	(b)		Candidates are expected to state the name of a suitable material for these parts **and** explain why this material is appropriate. **Responses are likely to include:** **Material:** • ABS • HDPE • Nylon • PVC • Polypropylene. **Justification:** • melting point/flow rate • chemical resistance/ease of cleaning • aesthetic qualities • durability/scratch resistance • impact resistance • flexible (only if related to assembly) • UV resistance/resistant to weathering. **Any other valid explanation.**	**3**	**1 mark** for identifying a correct material and up to **2 marks** each for correct justification. Up to **a maximum of 3 marks (1+2).** **NB up to 2 marks** can be awarded for correct justification of an incorrect material. Exemplar response: *Acrylic **(0 marks)** is suitable as it is chemical resistant for easy cleaning **(1 mark)** and durable to withstand children sliding down. **(1 mark)***

Question			Expected response	Max mark	Additional guidance
	(c)		Candidates are expected to outline steps that may have been taken to reduce the negative impact of products on the environment. **Responses are likely to include:** • using recyclable materials • materials from sustainable sources • labelling of plastic/metal components to assist recycling • use of recycled materials in the manufacture • use of processes that do not cause harm to the environment • manufacture close to the market to minimize transport • using efficient machinery • easily dismantled • easily transported (lightweight/stackable) • reduced volume of material used • reduce number of materials used • reduce number of manufacturing processes used • minimise waste • reuse components • reduced or no packaging • use of 'green' materials as an alternative • use of renewable energy for production • use of durable materials to increase lifespan of product. **Any other valid response.**	**4**	**1 mark** for each valid response. Up to **a maximum of 4 marks.** Exemplar response: *The material used may be biodegradable to allow the plastics to disintegrate after a while.* ***(1 mark)***

Question			Expected response	Max mark	Additional guidance
3.	(a)		Candidates are expected to describe the key stages of **two** research techniques. **Responses are likely to include:** **Survey/Questionnaire:** • identify target market • create questions relevant to market/product • distribute in an accessible way • gather responses • analyse information. **User trial:** • identify target market • gather focus group • distribute an existing product • give direction for use • gather feedback • analyse information. **User trip:** • identify target market • simulate user experience • consult with experts • gather feedback • analyse information. **Any other valid description.**	**4**	**1 mark** for each valid description of a key stage. Up to **a maximum of 4 marks (3+1).** **No marks** should be awarded for simply naming a research technique. Exemplar response: *A questionnaire could be used with a number of set questions that are given to the target market* ***(1 mark)*** *the results are then collected and analysed to be taken into a new design.* ***(1 mark)***

Question			Expected response	Max mark	Additional guidance
	(b)		Candidates are expected to outline the type of information that may be contained in **two** of the following specification types: • product design specification • performance specification • technical specification. **Responses are likely to include:** **Product design specification:** • number to be produced • target market • cost • aesthetic factors/branding • impact on environment • dimensions (minimum/maximum) • environment it will be used in • relevant safety standards • functional aspects • ergonomic aspects • desired life span. **Performance specification:** • operational aspects • battery life • durability • life span • compatibility with other products • operational environment (temperature, humidity, IP rating) • power usage/consumption.	**4**	**1 mark** for each correctly identified piece of information. Up to **a maximum of 4 marks (3+1).** Marks should only be given for responses for **two** of the specification types. If the candidate response includes all three the best two responses should be marked. Exemplar responses: *The product design spec will include the overall sizes to be considered **(1 mark)** and the colour to be used. **(1 mark)*** *The performance specification for a hairdryer would include the number of temperature settings. **(1 mark)*** *The technical specification will include the type of batteries to be used **(1 mark)** for example AA.*

Question			Expected response	Max mark	Additional guidance
			Technical specification: • materials for manufacture • production methods • assembly methods • tolerances • testing methods • packaging requirements • labelling • source of power • interface type (USB C, lightning connector) • dimensions (overall/parts/components) • weight • maintenance cycles. **Any other valid response.**		

Question			Expected response	Max mark	Additional guidance
4.	(a)		Candidates are expected to describe how graphics could be used during the design process. **Descriptions are likely to include:** **Sketches:** • used to quickly produce ideas • gets ideas on to a page quickly • gives a starting point for development • used to quickly explore idea. **Pictorial/3D drawings:** • give more detail • can give realistic proportions • used to further explore and develop ideas • can help with problem solving • helps show overall product. **CAD:** • can show realistic materials/finishes • can be exported for use in promotional materials • can give a highly realistic view. **Sectional views:** • used to show internal details/components • can show assembly details • helps manufactures to understand assembly. **Exploded views:** • gives detailed understanding of assembly • can be used to explore how components fit together.	**4**	**1 mark** for each valid description. Up to **2 marks** may be awarded for extended or detailed descriptions. Up to **a maximum of 4 marks.** **0 marks** should be awarded for simply naming graphic types. Exemplar answers: *Sketch models could be used to generate ideas quickly.* ***(0 marks)*** *Graphics could be used to show smaller parts through a detailed view.* ***(1 mark)***

Question			Expected response	Max mark	Additional guidance
			Working drawings: • exact measurements given • tolerances • surface finishes • parts list • production materials shown • production methods shown • assembly information. **Any other valid description.**		

Question			Expected response	Max mark	Additional guidance
	(b)		Candidates are expected to describe how physical models could be used during the design process. **Descriptions are likely to include:** **Sketch models:** • produced quickly to visualise ideas • check products scale (anthropometrics) • check functional issues, for example, stability etc • check operational issues, for example, levers, linkages, fitting parts • check aesthetic factors • development of initial ideas. **Block models:** • communicate and develop form • test ergonomics • presented to a client for advertising • aesthetics of the design • surface detail • position of buttons etc. **Test model** • functional suitability/efficiency/performance • structural suitability • material performance • health and safety regulations • allow for alterations to be made pre-manufacture. **Prototype** • test a fully working product/component • assist with marketing • provides clients with a fully working product (testing or promotion) • check for any flaws before actual production.	**4**	**1 mark** for each valid description. Up to **2 marks** may be awarded for extended or detailed descriptions. Up to **a maximum of 4 marks.** **0 marks** should be awarded for simply naming model types. **0 marks** should be awarded for descriptions relating to computer generated models. Marks should be awarded where a candidate incorrectly names a model type but gives a correct description of its use. Exemplar response: *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
			Scale models: • gather information on appropriate sizes • check the overall proportion • test ergonomics • check assembly methods. **Any other valid description.**		

Question			Expected response	Max mark	Additional guidance
5.	(a)		Candidates are expected to describe marketing techniques that could be used to launch new products. **Descriptions are likely to include:** • collaborations with other brands • celebrity/influencer endorsements • social media campaign (focussed on target market) • television/radio • magazine adverts • billboards • website/google ads • prelaunch competitions • sponsorship • introductory offer (price/BOGOF/product samplers). **Any other valid description.**	**4**	**1 mark** for each valid description. Up to **2 marks** may be awarded for extended or detailed descriptions. Up to **a maximum of 4 marks.** Exemplar responses: *Product testers could be used to let customers try your product. If they like it, it could entice them to buy more.* ***(1 mark)*** *Companies could launch new products with adverts on tv* ***(0 marks)****.*
	(b)		Candidates are expected explain why a strong brand image can lead to increased sales. **Responses are likely to include:** • consumer confidence • established customer base • customer loyalty • reputation for quality • 'buzz' or 'hype' around brand • social relevance/part of culture • attract higher profile celebrities for endorsement. **Any other valid response.**	**3**	**1 mark** each for a valid explanation. Up to **a maximum of 3 marks.** Exemplar response: *Strong brand image can lead to increase sales because people trust the brand and are more likely to buy your product.* ***(1 mark)***

Question			Expected response	Max mark	Additional guidance
	(c)		Candidates are expected to explain the factors that may cause product sales to decline. **Explanations are likely to include:** • market saturation • negative publicity • product has been superseded • competitor products • changes in style/fashion • poor marketing • mismanagement. **Any other valid explanation.**	**3**	**1 mark** for each valid description. Up to **a maximum of 3 marks.** Exemplar response: *Sales will decline because everybody that wants it has It.* ***(1 mark)***
	(d)		Candidates are expected to identify another method of IPR **and** give an example of what it protects. **Responses are likely to include:** **Method:** • design-right/registering the design • trademark • confidentiality/non-disclosure agreements • patent • watermarking. **Example:** • design-right/registering the design — shape/configuration of design • trademark — name or identity/logo • confidentiality — trade secrets, recipes, formulas • patent — protect new inventions, how they work, how they are made and what they are made from • watermarking — photo/video/audio. **Any other valid response.**	**2**	**1 mark** for correctly identifying an IPR method and **1 mark** for a valid example of what it protects. Up to **a maximum of 2 marks (1+1).** **No marks should be awarded for responses relating to copyright.**

Question			Expected response	Max mark	Additional guidance
6.	(a)		Candidates are expected to describe methods that could be used to identify the materials used in a product. **Descriptions are likely to include:** • flame test (only if clear indication of changes that occur is referenced) • float test • scratch test • cutting (looking for chips or slices) • testing for magnetism (ferrous metals) • grain pattern (wood only) • relative weight to a known material • identification symbols • comparisons to other materials (with example) • colour (wood and metal). **Any other valid description.**	**4**	**1 mark** for each valid description or **2 marks** for a detailed description of one method. **0 marks** for simply identifying a method. Exemplar responses: *Flame test is when a metal piece is heated and the flame changes colour and releases a smell.* ***(1 mark)*** *Different materials could be identified using symbols or letters somewhere on it.* ***(0 marks)***
	(b)		Candidates are expected to describe how manufacturing features could be used to ensure accurate and efficient assembly. **Descriptions are likely to include:** • bosses • location pins • asymmetric parts • labelling/numbered parts • housing for standard components • standard fixings • built-in fixings/raised edges • material properties • accuracy of construction • ribs/webs (rigidity of parts/locating components). **Any other valid description.**	**2**	**1 mark** for each valid explanation. Up to **a maximum of 2 marks.** **0 marks** for simply identifying the Manufacturing features. Exemplar response: *Jigs and templates can be used during manufacture as they assist in the accuracy of making parts.* ***(0 marks)*** *Location pins help the product slot together and stay in place.* ***(1 mark)***

Question			Expected response	Max mark	Additional guidance
	(c)		Candidates are expected to describe how automated production methods could impact the workforce and society. **Explanations are likely to include:** • reduced work force • reduced pay • unemployment • retraining of skills • de-skilling of work force/reduced training costs • changed work patterns • economic migration • increased safety of workplace • meet consumer demand • reduced cost of products • increased product availability. **Any other valid explanation.**	**4**	**1 mark** for each valid explanation. Up to **a maximum of 2 marks.** **0 marks** for simply identifying issues. Exemplar responses: *Automation produces products that are cheaper and more accessible to a wider range of people improving the quality of life.* ***(1 mark)*** *More skilled workforce are able to find better more secure jobs.* ***(0 marks)***

Question			Expected response	Max mark	Additional guidance
7.			Within their response, candidates are expected to explain why production and planning systems are used in the development and manufacture of new products. **Explanations are likely to refer to a range of production and planning systems; including:** **Production systems:** • 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. **Planning systems:** • Gantt charts, flow charts or any other sequence planning method. An understanding of appropriate use of production and planning systems and why they are used, such as: • improve lead-time • improved quality control • control product inventory • purchase inventory/storage of component parts reduced • reduce delays in purchasing of components • maximising output/less hours lost in production time • maximising workforce/labour requirements • maximising efficient use of plant machinery • production to satisfy customer needs • structured project planning of production (JIT) • increases quality assurance and control of production • increases productivity • reduces stock wastage • reduces manufacturing costs.	**8**	This question is set to test the candidate's ability to present a reasoned explanation why production and planning systems are used in the development and manufacture of new products. Although there is an underlying body of 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.

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 the use of production and planning systems • there is little or no reference to types of production and planning systems • 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 and understanding of the use of production and planning systems • the answer will be relevant to the question • reference is made to different types of production and planning systems • 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 and understanding of the use of production and planning systems • the answer will be relevant to the question and demonstrate a good level of comprehension • clear reference is made to types of production and planning systems • several clear points are made and examples are used to support them.	An answer which falls into this category may do so for a number of reasons. • **extensive** knowledge and understanding of the use of production and planning systems • the answer will be relevant to the question, demonstrating a high level of comprehension • detailed information is given about different types of production and planning systems and how they are used in the development and manufacture of products • all points made are clear and examples are used to support them.

[END OF MARKING INSTRUCTION]