



National
Qualifications
2017

2017 Design and Manufacture

Higher

Finalised Marking Instructions

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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) If a specific 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.
- (d) 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.
 - (iii) Questions that ask candidates to **discuss**
Candidates 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)	Candidate explanations should relate to the materials chosen for the cross trainers and/or their component parts.	6	<p>Six valid explanations at 1 mark each.</p> <p>No marks awarded for repetition of properties, benefits or characteristics.</p> <p>ABS:</p> <ul style="list-style-type: none"> • Good chemical resistance (easily cleaned) • Durable (can be used outdoors without deterioration) • Good strength/rigidity to withstand the weight of the user • Scratch resistant (maintains aesthetic look) • Impact resistant (tough at low temperatures) <p>Rubber:</p> <ul style="list-style-type: none"> • Easily formed • Non-slip surface for holding • Comfortable to hold on a frosty morning <p>Nylon:</p> <ul style="list-style-type: none"> • Durable (wear resistant) • Self-lubricating • Chemical resistant <p>Foam:</p> <ul style="list-style-type: none"> • Comfortable to hold • Provides a secure grip • Secure fit on cross trainer

Question	Expected response	Max mark	Additional guidance
			<p>Stainless Steel:</p> <ul style="list-style-type: none"> • Corrosion resistant • Tough • Durable • Aesthetic qualities <p>Acrylic:</p> <ul style="list-style-type: none"> • Transparent • Easily moulded/shaped • Strength/impact resistance • Durable <p>Plastic coated steel:</p> <ul style="list-style-type: none"> • Corrosion resistant (plastic coating) • Good strength to weight ratio • Can be easily machined • Ductile/malleable • Can be welded <p>ABS is a good choice of material for the footrest of the cross trainer as it is durable and will therefore not collapse under the weight of the user and it is chemical resistant which means it can be easily cleaned. (2 marks)</p> <p>Plastic coated steel is a good choice for the frame of the cross trainer because it has an excellent strength to weight ratio and is capable of being welded which makes the form of the frame easy to achieve. (2 marks)</p> <p>Stainless steel is used because it is strong. (0 marks)</p> <p>Marks should be awarded for any other suitable answer not included above.</p>

Question	Expected response	Max mark	Additional guidance
(b)	Candidates will name and explain the processes are appropriate. It is likely that they will relate to the materials used.	6	<p>Any three appropriate manufacturing processes and their suitability explained.</p> <p>Maximum of 3 marks for naming of processes (1 mark for each process).</p> <p>Maximum of 3 marks for explanations of suitability.</p> <p>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.</p> <p>NB Marks can be awarded for correct explanation of an incorrectly named process.</p> <p>Outdoor Cross Trainer</p> <ul style="list-style-type: none"> • Extrusion of main body sections to consistent cross section • Injection moulding of foot rests/nylon bearings • Moulding of rubber handles • Bending of frame • Welding of frame • Piercing (holes) • Blanking (plates) • Drilling • Die casting of fixings • Dip Coating

Question	Expected response	Max mark	Additional guidance
			<p>Indoor Cross Trainer</p> <ul style="list-style-type: none"> • Extrusion of main body sections to consistent cross section • Injection moulding of foot rests/body components • Moulding of foam handles • Bending of frame • Welding of frame • Piercing (holes) • Blanking (plates) • Drilling • Die casting of fixings • Powder coating • Assembly of components (screws for Acrylic screen) <p>Statements could explain:</p> <ul style="list-style-type: none"> • Repeatability of process • Accuracy of process • Level of detail achieved • Forms suitable for process • Economies of scale (Mass/Batch/JIT) • Quality of surface finish • Strength achieved through welding • Speed of assembly (bolts/screws) <p>The main frame of the outdoor cross trainer was manufactured using the process of extrusion to achieve a consistent cross section of material. (2 marks)</p> <p>The holes would then be drilled using a CNC machine to ensure they were accurately positioned. (2 marks)</p>

Question		Expected response	Max mark	Additional guidance
	(c)	The candidate is expected to describe how safety has influenced the design of the cross trainers.	4	<p>Four appropriate descriptions at 1 mark each.</p> <p>Answers could include:</p> <ul style="list-style-type: none"> • Stability (wide base) (secured to ground) • Finger traps (covers in place for moving parts) • Force required to operate (variable resistance) • Slip hazards (pattern on foot rest/raised edge) • Secure grip (appropriate use of materials) • Heart monitor of indoor cross trainer • Strength of construction (appropriate materials/assembly) • Electrical insulation of indoor trainer • Emergency stop button <p>Safety has been considered in the cross trainer by providing a pattern on the foot rest to ensure that your foot does not slip. (1 mark)</p> <p>Rubber handles provide the user with a safe and secure grip. (1 mark)</p>

Question	Expected response	Max mark	Additional guidance
(d)	The candidate is expected to describe five ergonomic considerations associated with the design of the cross trainer.	5	<p>Five appropriate descriptions at 1 mark each.</p> <p>The candidate must make reference to all areas of ergonomics to achieve full marks. Maximum of 3 marks for any single area (3+1+1) or (2+2+1).</p> <p>Candidate descriptions must relate to its appropriate area of ergonomics.</p> <p>Anthropometrics:</p> <ul style="list-style-type: none"> • Diameter of handles • Length of handles • Length of foot rests • Width of foot rests • Adjustability of indoor cross trainer • Height of foot rests above ground • Reach to handles • Range of movements <p>Candidates must relate anthropometrics to the products. (Ignore incorrect percentile range, if given)</p> <p>Physiology:</p> <ul style="list-style-type: none"> • Force required to operate cross trainer (designed to be variable) • Force required to stop cross trainer • Posture issues (comfort) • Limitations of dexterity • Strength required to relocate indoor cross trainer <p>Psychology:</p> <ul style="list-style-type: none"> • Looks simple to operate/user confidence • Looks safe to operate • Sounds smooth during operation • Sounds to indicate selections on indoor cross trainer • Feels robust during operation

Question		Expected response	Max mark	Additional guidance
	(e)	Candidates are expected to explain why CAD is used to develop these products.	4	<p>Any four explanations at 1 mark each.</p> <p>It is likely that these explanations will refer to benefits such as:</p> <ul style="list-style-type: none"> • Easier to alter the design • Library of parts • Carrying out testing such as stress analysis • 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 • Quicker than physical modelling • Production drawings easily created • Assisted production planning • Parts lists easily created <p>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) using digital technology. (1 mark) CAD can provide a virtual model to allow stress analysis to be carried out on component parts. (1 mark)</p>

Section 2

Question		Expected response	Max mark	Additional guidance
2.	(a)	Candidates are 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 <ul style="list-style-type: none">• 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• An open brief may not give the designer enough information to fully understand client needs

Question	Expected response	Max mark	Additional guidance
(b)	Candidates are expected to clearly describe appropriate research techniques for both aspects listed in the question.	4	<p>Four valid points at 1 mark each. Maximum of three marks per area (3+1).</p> <p>No marks for naming research technique.</p> <p>Responses are likely to describe the following methods:</p> <p>Needs of the target market:</p> <ul style="list-style-type: none"> • Focus groups • Questionnaires/Surveys • Analysis of market trends • Analysis of ergonomic data <p>Performance of existing product:</p> <ul style="list-style-type: none"> • User trials • User trips • Test rigs • Analysis of existing data (performance specifications) <p>The designer could organise a group of people from the target market to answer a prepared set of questions (1mark). Responses would be carefully analysed to provide key information (1 mark).</p> <p>The designer set up user trials where a product is tested by ‘real users’ in a controlled setting (1 mark) with a standardised set of tasks to perform. (1 mark)</p>

Question	Expected response	Max mark	Additional guidance
(c)	Candidates are expected to identify appropriate data that would be given in each specification type.	3	<p>Maximum of one mark per specification type.</p> <p>Product Design Specification A product design specification is produced before designing begins and would be used to specify design intent:</p> <ul style="list-style-type: none"> • Intended performance • Intended function • Intended aesthetic appeal • Intended ergonomic aspects • Intended target market/user <p>Any other suitable answer.</p> <p>Marketing Specification A marketing specification is produced prior to launching a product's advertising and marketing plan and would be used to identify:</p> <ul style="list-style-type: none"> • Intended market size in term of volume • Target market/consumer • Retail price • Any unique selling points (USPs) • Market sectors • Methods of advertising • Advertising budgets <p>Any other suitable answer</p>

Question	Expected response	Max mark	Additional guidance
			<p>Technical Specification A technical specification is produced after the product is designed and tested to identify:</p> <ul style="list-style-type: none"> • Materials • Dimensions • Weights • Maintenance cycles • Performance • Power supply • Fuel used • Comply with safety standards <p>Any other suitable answer.</p> <p>A product design specification contains statements of what a product is intended to do. Its aim is to ensure that the design and development of a product meets the needs of the user. (1 mark)</p> <p>The marketing specification document outlines the product's key attributes, considers the competition and identifies its target market. (1 mark)</p>

Question		Expected response	Max mark	Additional guidance
3.		Candidates are expected to describe how environmental considerations have influenced the design, production and disposal of this product .	4	<p>Four descriptions at one mark each.</p> <p>Descriptions are likely to be drawn from:</p> <ul style="list-style-type: none"> • The stacking allows more of the product to be packed and transported and stored more efficiently • Lightweight product reduces transport costs • The product can be recycled easily (thermo-plastic) • The product can be recycled easily (only one material used) • The product could be made from recycled material • One step efficient manufacturing process • No additional finishing • Minimal material required • Inclusion of recycling marks • No packaging therefore less material used <p>Any other suitable answer.</p>

Question	Expected response	Max mark	Additional guidance
4.	Candidates are expected to explain the purpose of each model type and identify how information gained from modelling could be used.	6	<p>Marks are awarded for explanation of purpose (1 mark) and identification of use of each model type. (A maximum of two marks can be awarded for each model type)</p> <p>Sketch models are used to:</p> <ul style="list-style-type: none"> • Quickly produce concept ideas • Quickly produce development ideas <p>To assist with development of:</p> <ul style="list-style-type: none"> • Functional factors • Ergonomic factors • Aesthetic factors <p>Any other suitable answer.</p> <p>Test models are used to:</p> <ul style="list-style-type: none"> • check a range of issues associated with products and their components <p>To provide information on:</p> <ul style="list-style-type: none"> • Functional suitability/efficiency/performance/working environment • Structural suitability of product • Material performance • Compliance with Health & Safety regulations • Product lifespan/obsolescence • Allow alterations to be made <p>Any other suitable answer.</p>

Question	Expected response	Max mark	Additional guidance
			<p>Prototypes are used to:</p> <ul style="list-style-type: none"> • Test a fully working product/component • Assist with marketing • Provide clients with a fully working product (for testing) • Check for flaws <p>Information gained:</p> <ul style="list-style-type: none"> • Allow alterations to be made before beginning production • Ensure that the final product meets the given brief/performance issues • Allow testing by potential customers/focus groups • Gauge the market opinion <p>Any other suitable answer.</p>

Question		Expected response	Max mark	Additional guidance
5.	(a)	Candidates are expected to identify an appropriate material for manufacture and justify their choice.	2	<p>One mark for identification of correct material and one mark for the correct justification. Justification given must be relevant to material.</p> <p>Material:</p> <ul style="list-style-type: none"> • ABS • Polypropylene (PP) • Polystyrene • HDPE <p>Justification:</p> <ul style="list-style-type: none"> • Lightweight and rigid when formed by injection moulding • Impact resistant • Chemical resistant/easy to clean • Toughness • Heat resistance • Scratch resistant <p>Any other suitable answer.</p> <p>Do not accept 'suitable for injection moulding'. Do not accept 'durable'.</p>

Question		Expected response	Max mark	Additional guidance
	(b)	Candidates are expected to explain why draft angles and/or webs/ribs are incorporated into mould designs.	2	<p>One mark for each valid explanation of draft angles and/or webs/ribs.</p> <p>Draft angles</p> <ul style="list-style-type: none"> • Allow the component to be easily removed from the mould at the end of the production cycle • Reduces wear on mould components <p>Webs/Ribs</p> <ul style="list-style-type: none"> • Add strength and rigidity to the finished component • Allow the plastic to flow evenly into all areas of the mould • Allow location of internal components

Question		Expected response	Max mark	Additional guidance
	(c)	Candidates are expected to explain two advantages of using standard components in this clock radio.	2	<p>One mark for each valid explanation.</p> <p>Responses are likely to include:</p> <ul style="list-style-type: none"> • Assumed quality of bought components • Reduced production costs • Supplied in common sizes/ratings • Ease of replacement by consumer • Allows parent company to focus on development of their product by outsourcing <p>Any other suitable answer.</p>

Question		Expected response	Max mark	Additional guidance
	(d)	Candidates are expected to examine the aesthetic look of the clock radio.	4	<p>Four appropriate comments at one mark each.</p> <p><i>Candidates must refer to four different aesthetic aspects.</i></p> <p>Aesthetic appeal is likely to be examined in terms of:</p> <ul style="list-style-type: none"> • Shape • Line • Form • Proportion • Pattern • Light • Texture • Colour • Fashion • Style/brand • Contrast • Harmony • Balance/symmetry • Market trends <p>The clock radio is neutral in colour which makes it suitable for a wider market. (1 mark)</p> <p>The clock radio provides a contrast between the smooth casing surfaces and the rough texture of the patterned surface. (1 mark)</p>

Question		Expected response	Max mark	Additional guidance
	(e)	Candidates are expected to describe the actions that could be taken by the company to ensure that the clock radio remain competitive in the marketplace.	4	<p>Four appropriate descriptions at one mark each.</p> <p>Description are likely to be taken from:</p> <ul style="list-style-type: none"> • Reduced price to improve sales • Increase marketing/advertising • Celebrity endorsement • Use alternative or cheaper materials • Purchase components from more economical suppliers (reduced costs) • Use more efficient manufacturing processes (reduced costs) • Available in a range of colours (target market choice) • Minor changes to functionality • Minor changes to aesthetics <p>Any other suitable answer.</p>

Question	Expected response	Max mark	Additional guidance
6.	<p>Candidates are expected to explain the benefits of using composite materials.</p> <p>These can take the form of: Wood - Manmade board Metal - Alloys Plastics.</p>	4	<p>Four explanations at one mark each.</p> <p><i>Candidates should make reference to products within their answer.</i></p> <p><i>Where no reference to products is made, a maximum of 1 mark can be awarded.</i></p> <p>Explanations are likely to be drawn from:</p> <ul style="list-style-type: none"> • Individual properties blend to give the composite improved properties • Aesthetics • Durability • Rigidity • Impact resistance • UV resistance • Reduced corrosion • Strength/weight ratio • Increased dimensional stability • Part Consolidation i.e. one composite part as opposed to various assembled parts • Design flexibility (easier to form) <p>Any other suitable answer.</p> <p>A composite is a mixture of two or more materials that can improve properties such as durability and rigidity that will allow for an increase in wear and tear and still maintain structural integrity. (1 mark)</p> <p>In sledge manufacture, composites are used to improve properties such as durability and rigidity that allow for an increase in wear and tear and still maintain structural integrity. (2 marks)</p> <p>Kitchen knives are manufactured using stainless steel as they do not rust and maintains its aesthetic appeal. (2 marks)</p>

Question	Expected response	Max mark	Additional guidance
7.	<p>This question is set to test the candidate's ability to present a reasoned discussion about Production and Planning methods.</p> <p>Although there is an underlying body of knowledge required to answer it, there is a very wide range of possible answers.</p> <p>Therefore, the question is marked holistically.</p> <p>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.</p> <p>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.</p> <p>The table below is designed to assist with the placing of answers within the full mark range.</p>	8	<p>Explanations are likely to make reference to some of the methods below:</p> <p>Production methods</p> <ul style="list-style-type: none"> • One-off production (prototypes), Batch production, Mass production, Line, Flow, Use of jigs/fixtures, Use of patterns, Use of standard components, CAD/CAM, CNC machining (automation), Rapid prototyping, JIT, Sub-contracting, Quality control <p>Planning systems</p> <ul style="list-style-type: none"> • Gantt charts, Flow charts or any other sequence planning method <p>An understanding of appropriate use of production methods and planning systems and the effects they have on manufacturing efficiency, such as:</p> <ul style="list-style-type: none"> • Lead-time • Product inventory • Purchase inventory/storage of component parts reduced • 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) • Increased quality assurance and control of production • Increased productivity • Reduction in stock wastage • Reduction in manufacturing costs <p>Any other suitable answer.</p>

0 - 2 marks	3 - 4 marks	5 - 6 marks	7 - 8 marks
<p>An answer which falls into this category may do so for a number of reasons.</p> <ul style="list-style-type: none"> • Limited knowledge or understanding of the use of production methods and planning systems to improve efficiency. • 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. 	<p>An answer which falls into this category may do so for a number of reasons.</p> <ul style="list-style-type: none"> • Adequate knowledge and understanding of the use of production methods and planning systems to improve efficiency. • 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. 	<p>An answer which falls into this category may do so for a number of reasons.</p> <ul style="list-style-type: none"> • Secure knowledge and understanding of the use of production methods and planning systems to improve efficiency. • 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. 	<p>An answer which falls into this category may do so for a number of reasons.</p> <ul style="list-style-type: none"> • Extensive knowledge and understanding of the use of production methods and planning systems to improve efficiency. • 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 INSTRUCTIONS]