



GCE AS MARKING SCHEME

SUMMER 2022

**AS
DESIGN AND TECHNOLOGY – PRODUCT DESIGN
B602U10-1**

INTRODUCTION

This marking scheme was used by WJEC for the 2022 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conference, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

EDUQAS GCE AS DESIGN AND TECHNOLOGY - COMPONENT 1

PRODUCT DESIGN

SUMMER 2022 MARK SCHEME

Marking guidance for examiners

Summary of assessment objectives for Component 1

The questions on this exam paper assess aspects of AO3 and all of AO4.

Within AO3, this exam paper assesses:

Analyse and evaluate –

- *wider issues in design and technology*

Within AO4, this exam paper assesses:

Demonstrate and apply knowledge and understanding of –

- *technical principles*
- *design and making principles*

In the mark grids, the marks allocated to assessment objectives are shown with respect to specific elements:

AO3 2a	analyse wider issues in design and technology
AO3 2b	evaluate wider issues in design and technology
AO4 1a	demonstrate knowledge of technical principles
AO4 1b	demonstrate understanding of technical principles
AO4 1c	apply knowledge and understanding of technical principles
AO4 2a	demonstrate knowledge of designing and making principles
AO4 2b	demonstrate understanding of designing and making principles
AO4 2c	apply knowledge and understanding of designing and making principles

The structure of the mark scheme

In low-tariff questions, the mark scheme includes indicative content which should be used to assess the quality of the candidate's response. The content is not prescriptive and candidates are not expected to mention all material referred to. Examiners should seek to credit any further relevant evidence offered by the candidates.

In high-tariff questions, the mark scheme has two parts:

- An assessment grid showing bands and associated marks that should be allocated to responses which demonstrate the characteristics required by the appropriate assessment objectives relevant to the question
- Indicative content which should be used to assess the quality of the specific response. The content is not prescriptive and candidates are not expected to mention all material referred to. Examiners should seek to credit any further relevant evidence offered by the candidates.

Applying the mark scheme

Stage 1 - Deciding on the band

Beginning at the lowest band, examiners should look at the candidate's response and check whether it matches the descriptor for that band. If the descriptor at the lowest band is satisfied, examiners should move up to the next band and repeat this process for each band until the descriptor matches the answer. Examiners should not seek to mark candidates down as a result of small omissions in minor areas of an answer.

Stage 2 - Deciding on the mark

During standardising (marking conference), detailed advice from the Principal Examiner on the qualities of each mark band will be given. Examiners will then receive examples of answers in each mark band that have been awarded a mark by the Principal Examiner. Examiners should mark the examples and compare their marks with those of the Principal Examiner.

When marking, examiners can use these examples to decide whether a candidate's response is of a superior, inferior or comparable standard to the example. Examiners are reminded of the need to revisit the answer as they apply the mark scheme in order to confirm that the band and the mark allocated is appropriate to the response provided.

Indicative content is also provided for banded mark schemes. Indicative content is not exhaustive, and any other valid points must be credited. In order to reach the highest bands of the mark scheme a candidate need not cover all of the points mentioned in the indicative content but must meet the requirements of the highest mark band. Where a response is not creditworthy, that is contains nothing of any significance to the mark scheme, or where no response has been provided, no marks should be awarded.

Where questions target multiple assessment objectives, an answer may deserve to be awarded marks from different bands for different assessment objectives. Where questions target more than one element within an assessment objective, and those elements are conflated and not considered separately within the mark scheme, examiners must not attempt to apportion marks within that assessment objective by element.

In summary:

- the first stage for an examiner is to use both the indicative content and the assessment grid to decide the overall band;
- the second stage is to decide how firmly the characteristics expected for that band are displayed;
- thirdly, a mark for the question is awarded.

Section A

Question 1

The image below shows a soap dispenser made from brushed aluminium.

- (a) Describe **two** properties of brushed aluminium that make it a suitable material for the soap dispenser.
- (b) Describe **two** different aesthetic features evident in the soap dispenser
- (c) Explain **one** advantage of obtaining a 'registered design' to the manufacturer of the soap dispenser

Q1	Science	Maths		AO3		AO4					Total
						1a	1b	1c			
(a)						4					4

Learners should demonstrate understanding and are awarded up to 4 marks

Award 1 mark for each property of aluminium that makes it appropriate for the soap dispenser and 1 mark for the justification up to a total of 4 marks.

- Aluminium has very good resistance to corrosion [1] therefore it will last longer and can be washed [1].
- Aluminium is very lightweight [1] making it suitable for a product that needs handling and filling with liquid. [1]
- Aluminium is impermeable [1] preserving the liquid soap inside for longer [1]
- Aluminium is recyclable [1] making it a better choice for the environment [1]

Credit any other appropriate response.

	Science	Maths		AO3		AO4					
						1a	1b	1c			
(b)	✓						4				4

Learners should demonstrate application of knowledge and understanding and are awarded up to 4 marks.

Award 1 mark for a description and 1 mark for a justification or appropriate supporting comment up to a total of 4 marks.

- The product shape/contour needs to be considered [1] to enable the products to be comfortably held especially when changing the liquid soap [1].
- The texture of the aluminium needs to be considered [1] to ensure it is more decorative and desirable such as applying a brushed finish [1].
- The styling of the product needs to be considered [1] to make it more desirable e.g. a clean and simple design [1].

Credit any other appropriate response.

	Science	Maths		AO3		AO4					
						1a	1b	1c			
(c)						2					2

Learners should demonstrate knowledge and are awarded up to 2 marks

Award 1 mark for an advantage and 1 mark for a justification or appropriate supporting comment up to a total of 2 marks.

A UK registered design gives a “monopoly” right, i.e. a right to stop anybody else using the registered design irrespective of whether they copied it.

The registered design applies to its appearance, physical shape, configuration or decoration [1] providing the owner with comprehensive protection from being copied [1]
Intellectual Property - without a registered design the company has no legal rights [1] and the idea or logo can be copied or reproduced [1]

Credit any other appropriate response.

Question 2

A 3D printed rapid prototype of a can holder is shown below.

- (a) Justify **two** advantages to the manufacturer of using a 3D printer to rapid prototype the can holder.
- (b) Name a material used to 3D print this can holder and explain why this material is suitable.

The diagram below is a front view of the product showing measurements in millimetres.

- (c) Calculate the total surface area of the front view of the product. *Show all workings*

The graph below shows the number of annual sales of the cup holder over an eight-year period.

- (d) (i) Calculate the mean sales figures between Year 2 and Year 5 inclusive. *Show all workings.*
- (ii) Calculate the predicted sales figure for Year 9 if sales continue to drop at the same rate as Year 8
(*Show all workings and round your answer to the nearest whole number.*)

Q2	Science	Maths		AO3		AO4					Total
						1a	1b	1c	2a		
(a)							4				4

Learners should demonstrate application of knowledge and understanding and are awarded up to 2 marks.

1 mark for a naming an advantage of using the 3D printer to rapid prototype and 1 mark for a justification or supporting reason up to a total of 4 marks

The design can be tested in simulations [1] to ensure that the product will work as effectively as possible [1]

The design can be produced quickly [1] therefore speeding up the design process [1]

The design can be easily changed or modified [1] enabling the designer to improve the product in an iterative way [1]

The design/ideas can be shared with others [1] leading to collaborative designing [1]/ aids the iterative process [1]/ can be sent as trail to others [1] to get immediate feedback [1]

Credit any other appropriate response.

	Science	Maths		AO3		AO4				
						1a	1b	1c	2a	
(b)						2				2
Learners should demonstrate application of knowledge and understanding and are awarded up to 2 marks. 1 Mark for correct identification of an appropriate material e.g. PLA Polylactic acid, ABS Acrylonitrile butadiene styrene. 1 mark for an advantage of named material to 3D Prototype the product Has a low melting temperature 210 degrees for PLA, 240 for ABS approx. [1] making it ideal to use on 3D printer nozzles [1] Comes in a myriad of colours [1] enabling the designer to try many variations of the design [1] PLA is biodegradable [1] making it a better choice for the environment than petroleum-based plastics [1] Do not accept Polypropylene, LDPE, HDPE <i>Credit any other appropriate response.</i>										

	Science	Maths		AO3		AO4				
						1b				
(c)		4				4				4

Learners should demonstrate understanding and be awarded up to 4 marks based on:

Rectangle Surface Area =
 $100 \times 150 = 15000^2$

1 mark

Calculate Half Circle Area

Circle Area

$$A = \pi r^2$$

$$A = \pi \times 50^2$$

$$A = 7,853.98$$

Divide by 2 [1/2 Circle]

$$A = 7,853.98/2$$

$$A = 3926.99$$

1 mark

Calculate Hole Surface Area

Circle Area

$$A = \pi r^2$$

$$A = \pi \times 45^2$$

$$A = 6361.73$$

1 mark

Calculate Total Surface Area

Rectangle + $\frac{1}{2}$ Circle – Hole

$$15000 + 3926.99 = 18926.99$$

$$18026.99 - 6361.73$$

$$= 12,565.26$$

Answer = $12,565\text{mm}^2$ **1 mark**

Accept the following answer if candidates use 3.142 Or $\frac{22}{7}$ as π rather than using a formula on the calculator:

$$3.142 \times 50 \times 50 = 7855$$

$$7855/2 = 3,927.5$$

Allow rounded or unrounded answers

Credit any other appropriate mathematical response.

	Science	Maths		AO3		AO4				
						1b				
(d) (i)		2				2				2
Learners should demonstrate understanding and be awarded up to 2 marks based on: Add up total sale figures across the years $4300 + 5000 + 6300 + 7000 = 22,600$ 1 mark Divide total by number of years $22600 / 4 = 5650$ 1 mark										
(ii)		4				3				3
Learners should demonstrate understanding and be awarded up to 3 marks based on: Calculate the percentage drop from Year 7 to Year 8 $3020 \times 100 / 4600$ $= 65.65\%$ Percentage drop $= 100 - 65.65 = 34.35\%$ 1 mark Apply percentage drop to Year 8 figures 3020×0.3435 $= 1037.37$ Rounded to a whole number $= 1037$ 1 mark Reduce the 'drop' number from the Year 8 sales $3020 - 1037 = 1983$ Predicted sales for year 9 = 1983 1 mark <i>Credit any other appropriate mathematical response.</i>										

Question 3

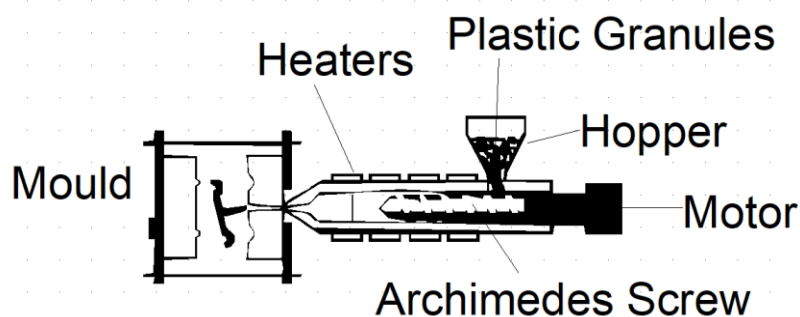
Study the image below showing a water bottle spray.

- (a) Use notes and diagrams to describe how the water spray nozzle has been manufactured using injection moulding.
- (b) Justify why polypropylene is a suitable material for the water spray nozzle.

Q3	Science	Maths		AO3		AO4						Total
						1a	1b	1c	2a			
(a)						4						4

Learners should demonstrate knowledge and are awarded up to 4 marks.

The candidate should produce a diagram with appropriate supporting notes to be awarded the full 4 marks. Award up to 3 marks for appropriate notes without diagrams. Award up to 3 marks for detailed diagrams but without any appropriate notes.



1. Plastic granules are placed into the Hopper.
2. The plastic granules move to the next stage, where they are heated to 300°C whilst moving along the Archimedes screw via the motor.
3. The polypropylene is injected into the mould
4. The mould is water cooled and the mould pushed out by rods.

Credit any other appropriate response.

	Science	Maths		AO3		AO4					
						1a	1b	1c	2a		
(b)	✓								4		4

Learners demonstrate knowledge and are awarded up to 4 marks based on:

Award 1 mark for each benefit and 1 mark for a justification or appropriate supporting comment up to a total of 4 marks.

Polypropylene has resistance to water [1] making it suitable for a product that may be used outside to avoid corrosion [1]

Polypropylene is durable [1] making it ideal for a water spray, which may take a lot of wear and tear particularly the components on the handle and lever [1].

Polypropylene can be recycled [1] and therefore is better for the environment [1]

Polypropylene is a relatively cheap material [1] keeping the cost down for consumers [1]

Award no marks for saying that Polypropylene is suitable because it can be injection moulded.

Credit any other appropriate response.

Question 4

The cotton reel storage stand below is made from beech.

- (a) Explain why beech is a suitable material for this product.
- (b) (i) The cotton reel storage stand costs £2.43 to manufacture. Calculate the selling cost of the cotton reel storage stand if the manufacturer makes 30% profit.
- Show all workings.
- (ii) Below is a working drawing of the adjustable leg to enable the product to stand.
- Calculate the length of the leg labelled A-B
All dimensions in mm [not to scale]
- (c) The manufacturer uses a jig to drill the holes in the beech cotton reel stand. Explain one advantage to the manufacturer of using a drilling jig

Q4	Science	Maths		AO3		AO4					Total
						1a	1b	1c			
(a)	✓					2					2

Learners should demonstrate knowledge and are awarded up to 2 marks.

Award 1 mark naming an appropriate property and 1 mark for a suitable justification up to 2 marks.

Beech is a relatively heavier wood [1] making the product more stable [1]

Beech is relatively hard and durable [1] making the product last longer [1]

Beech can be easily machined, cut and drilled [1] making it ideal for the construction of the product [1]

Credit any other appropriate response.

	Science	Maths		AO3		AO4					Total
						1a	1b	1c			
(b) (i)	✓	2						2			2
Learners should demonstrate knowledge and understanding and be awarded up to 3 marks based on: $£2.43 \times 1.3$ $=£3.159$ 1 mark <i>Rounded = £3.16</i> 1 mark Accept any appropriate mathematical process.											
(ii)	✓	4						4			4
Learners should demonstrate knowledge and understanding and be awarded up to 2 marks based on: Identifying the correct formula $\sin = o/h$ 1 mark Applying Correct formula $\sin x = \text{opposite/hypotenuse}$ $\sin 65 = AB/330$ $AB = 330 \times \sin 65$ 1 mark $AB = 299.081$ $AB = 299\text{mm}$ 2 marks Accept any appropriate mathematical process.											
(c)							2				2
Learners should demonstrate an understanding and are awarded up to 2 marks. Award 1 mark for a benefit and 1 mark for a justification or appropriate supporting comment up to a total of 2 marks. Drilling jigs eliminate the need for marking out, positioning [1] resulting in faster production of the product and efficiency [1] Less skilled workers are required to make the product [1] resulting in cost reductions [1] Drilling jigs can be adapted for a number of different products [1] therefore providing the manufacturer with more flexibility [1] A Jig would increase accuracy [1] and therefore guarantee repeatability/identical products [1] <i>Credit any other appropriate response.</i>											

Question 5

The images below show bookstands made from sheet steel.

- (a) Describe **one** reason why stamping the shape out of the sheet steel is a suitable manufacturing method for this product.
- (b) Explain the benefits of using standard steel stock forms to the manufacturer of the book stands.

Q5	Science	Maths		AO3		AO4					Total
						1a	1b	1c			
(a)						2					2

Learners should demonstrate knowledge and are awarded up to 4 marks.

Award 1 mark for an explanation and 1 mark for a justification or appropriate supporting comment up to a total of 2x2 marks.

Stamping (also known as pressing) is the process of placing flat sheet metal into a stamping press where a tool and die surface forms the metal into a net shape. Stamping includes a variety of sheet-metal forming manufacturing processes, such as punching using a machine press or stamping press, blanking, embossing, bending, flanging, and coining. This could be a single stage operation where every stroke of the press produces the desired form on the sheet metal part or could occur through a series of stages.

The stamping and forming process could be carried out at the same time [1] speeding up the manufacturing process [1]

The product has only one-fold on each bookend [1] keeping the process simple [1]

Stamping is a quick process [1] keeping the manufacturing costs cheaper [1]

More than one product could be stamped at the same time on one metal sheet [1] therefore speeding up manufacture [1] will be more economical use of the sheet [1]

Credit any other appropriate response.

(b)							5				5
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Learners should demonstrate understanding and are awarded up to 5 marks based on:

- Standard forms can be transported and handled more easily than raw materials therefore reducing costs to the manufacturer and therefore reducing the cost price of the product.
- Designers use readily available standard stock sizes when designing products and therefore reduce costs
- Readily available standard stock sizes lead to consistency in design across different companies creating more efficiency
- Standard forms and sizes are generally the same in most countries [international standard] and therefore promote global production

Credit any other appropriate response.

Question 6

- (a) Explain what primary and secondary research strategies a designer could use prior to re-designing the cordless drill shown below.
- (b) Analyse how the international standards information used on the drill offers protection to the consumer

Q6	Science	Maths		AO3		AO4					Total
						1a	1b	1c	2a	2b	
(a)							5				5
Learners should demonstrate understanding and are awarded up to 5 marks based on: - Primary consumer market research will provide the company with up-to-date responses from the marketplace and perceived needs [1]. This information can then be incorporated into the design or redesign of the product leading to increased attention value. [1] - Primary consumer market research such as questionnaires/surveys can provide effective profile information of a target market [1] allowing the designer to meet the interests of the demographic. [1] This can include telephoning, creating questionnaires, visits, testing materials, product disassembly [1] - Primary consumer market research can analyse the effectiveness of design [1] - Secondary research techniques can be speed up the design process [1] as information can be found rather than created. [1] examples include Internet research, looking at books/magazines, use of social media/blogs [1] For full marks candidates must address both Primary and Secondary. <i>Credit any other appropriate response.</i>											
(b)				5							5
Candidates should show evidence of <u>deconstructing information to find connections and provide logical chains of reasoning</u>, and then <u>apply</u> this to be awarded up to 5 marks. Indicative content: EAC certification European/Asian for technical regulations CE Mark - Conformité Européenne Waste Electrical and Electronic Equipment Directive ISO Mandatory Action Label – read operators manual International standards marking helps to support basic consumer rights, such as the right to safety and the right to be informed CE marking and EAC marking is the manufacturer's declaration that the product meets the requirements of the applicable EC directives and as such helps support basic consumer protection helps to raise levels of quality, safety, reliability in products which is better for the consumer . If placed on a product it means that the product has met a standard which means it can be legally be sold in the European Economic Area/ Euro-Asia area this protects the consumer in terms of legal protection and litigation for damages.											

The application of CE marking for electronic products covers electrical safety

- Low voltage directives
- Electro-magnetic compatibility
- Restriction of Hazardous substances
- Eco design directive [ERP]

This protects the consumer as they have assurance that the product will be electrically safe. Consumers can make better purchase decisions by looking for the marking and not purchasing products without the marking

Specific labelling places instructions for safe use and disposal on the consumer.

Credit any other appropriate response

Band	Marks	AO3 2a
2	3-5	Good analysis of the use of international standards. A sound discussion, which deconstructs information and provides adequate connections and reasoning. Generally well-considered and relevant factors used as a context for the discussion
		There is a line of reasoning which is generally coherent, mainly relevant and with some evidence and structure.
1	1-2	Limited analysis of the use of international standards. Little evidence of deconstructing information and limited connections are made. Few factors are identified.
		There is limited evidence of relevant examples or structure.
	0	No response or work that is worthy of a mark

Question 7

Composite materials such as Fibreglass, Carbon Fibre and Kevlar/Aramid are used in many ways on modern bikes.

- (a) Analyse how composite materials are used when manufacturing modern bikes.
- (b) Evaluate the impact of using bought-in or standardised part-assembled components to the manufacturer of modern bikes.

Q7	Science	Maths		AO3		AO4				Total
				2a	2b	1c	2a	2b	2c	
(a)				5						5

Candidates should show evidence of deconstructing information to find connections and provide logical chains of reasoning, and then apply this to be awarded up to 6 marks. Indicative content:

The following points could be discussed:

Most composites are made of just two materials. One is the matrix or binder. It surrounds and binds together fibres or fragments of the other material, which is called the reinforcement.

Composite parts provide superior strength, stiffness and light weight, and can be formed into any shape.

Typical composite materials can be made with fibres such as fiberglass, carbon fibre (graphite) and Kevlar.

The fibres come in veil mat, short fibres mat, woven cloth, unidirectional tape, biaxial cloth or triaxial cloth.

The resins are typically thermal set resins such as polyester, vinyl ester, epoxy, polyurethane and phenolic.

- Many composite materials have the ability to be painted, spray finished, screen printed, and accept decals and graphics for finishing.

Composite materials have replaced traditional steel frames. The frame represents the most common use of composite materials in a bike. Other examples include, forks, cranks and wheels [graphene]. Tyres can have Kevlar in them.

Fibreglass

The most widely used composite material is fiberglass in polyester resin, which is commonly referred to as fiberglass. Fiberglass is lightweight, corrosion resistant, and economical, easily processed and has good mechanical properties.

- Cheaper option compared to other composites.
- Easy to control in the manufacture of the bike.
- Made from fine strands of glass, woven together and combined with resin to increase strength and stiffness.
- Tends to be placed on another material to increase strength of the product for example placed onto a head of a wooden stick to improve impact resistance and resistance to wear and fatigue.

Kevlar/Aramid

Kevlar® is a very strong artificial fibre. [stronger than fibreglass] It is woven to make a material that is used for light and flexible used in various sports equipment.

- Very strong but also flexible allowing better performance
- Very resistant to impact and abrasion damage making it ideal for tyres
- It can be made waterproof when combined with other materials like epoxy.

Carbon Fibre

Advantages for use on bikes: high temperature resistance, corrosion resistance, light weight, high mechanical strength

- Carbon in the form of graphite is soft, slippery and easily broken. But very thin filaments of carbon are very stiff. These carbon fibres are useful for reinforcing other materials to make them tougher. Made from light strands of carbon woven into thin sheets or strips.
- These are usually very strong but lightweight equipment. The larger the ratio of carbon fibre weave the lighter.
- Very thin compared to other composites which reduces the weight ratio for the sports equipment and therefore leads to better performance.
- Relatively expensive in comparison to other composites resulting in more expensive bikes.
- Carbon Fibre is the material used to create the stiffness in sports equipment, the more carbon fibre the stiffer it is.
- The weakness of carbon fibre is its low resistance to impact and brittleness which can cause breakage. Carbon Fibre is often combined with Kevlar/Aramid to take advantage of its strength and prevent breakage. Kevlar /Aramid is very strong but flexible and when combined with carbon fibre, allows better performance.

Credit any other appropriate response.

Band	Marks	AO3 2a
2	3-5	Good analysis of using composite materials in a bike. A sound discussion, which deconstructs information and provides adequate connections and reasoning. Generally well-considered and relevant factors used as a context for the discussion
		There is a line of reasoning which is generally coherent, mainly relevant and with some evidence and structure.
1	1-2	Limited analysis of the using composite materials in a bike. Little evidence of deconstructing information and limited connections are made. Few factors are identified.
		There is limited evidence of relevant examples or structure.
	0	No response or work that is worthy of a mark

	Science	Maths		AO3		AO4					
				2a	2b	1c					
(b)				5							5

Candidates should show clear evidence of appraisal and/or making judgements and then apply this to technical principles to be awarded up to 5 marks.

Issues that the learner could be discussing:

Advantage to company

- Standardised parts are a key feature in saving manufacturing costs in industry and in the context of a mountain bike can include nuts, bolts, screws or springs.
- They don't need to specialise in creating the standardised part.
- No space required in the factory to make these parts.
- Save costs – no extra machinery/staff needed to produce these parts.
- Standardised parts can be used across a range of bikes produced by the company and therefore simplifies design and uniformity.

Disadvantage to the company

- Quality cannot be guaranteed [many companies have to put in quality control processes] they have to be sure the components are of a high standard, safe, within tolerance [correct size, shape, weight etc.]
- Many parts need to use standardised sizes e.g. metric thread. In the case of nuts, bolts, and screws consumers do not have to buy replacement parts from the manufacturer as these parts are commonly found.
- Dependency on other companies for stock and delivery. A key feature is that standardised parts arrive just before the product is manufactured [JIT]. Delay in the arrival of standardised parts can affect production times.

Credit any other appropriate response.

Band	Marks	AO3 2b
2	3-5	Good evaluation how using bought-in or standardised part-assembled components affects the manufacturer. A sound discussion which appraises and/or makes judgements about how using bought-in or standardised part-assembled components affects the manufacturer. Generally well-considered, relevant issues used as a context for the discussion.
		There is a line of reasoning which is generally coherent, mainly relevant and with some evidence and structure.
1	1-2	Limited evaluation how using bought-in or standardised part-assembled components affects the manufacturer. Little evidence of appraising or making judgements about how using bought-in or standardised part-assembled components affects the manufacturer.
		There is limited evidence of relevant examples or structure.
	0	No response or work that is worthy of a mark

Question 8

Quality Control (QC) and Quality Assurance (QA) are critical when manufacturing products.

Explain the difference between Quality Control (QC) and Quality Assurance (QA) when manufacturing the hair straighteners shown.

Q8	Science	Maths		AO3		AO4					Total
				2a		1b	2b	2c			
						4		5			9

Learners should provide evidence of logical reasoning or deconstructing information and applying this to be awarded up to 9 marks based on:

Learners could discuss:

Quality Control

QC is in all stages of the manufacturing process and used to test if the product works, is within a tolerance range, has been assembled correctly, to ensure no surface defects.

Examples include:

- the use of measurement checks, process/checklists, signing in/out of tools,
- product testing,
- visual checks,
- Use of CAD/CAM,
- Use of templates, jigs and gauges.

QC is to ensure high quality, that the product works well and to ensure consumer satisfaction.

Some products will be tested at random e.g. 1 in every 100.

Every electrical product will have to be tested due to safety compliance.

Quality Assurance

QA is more than the quality of the finished product. QA involves the whole company and how consumers view that company.

Examples include:

- Work force happy and encouraged to develop and partake in staff training, decent wages and treated well.
- Product manufactured in a safe environment.
- No waste products or harm done to the environment when the product is made.
- Use of recycled materials.
- Produced from materials that do not harm the environment.
- Customer satisfaction – guarantees and warranty on products.

Benefits to the manufacturer:

- Standard and consistent parts reduce manufacturing parts.
- Makes production run more efficiently.
- Reduces risk of incorrect or bad parts being made.
- Allows products to get approval for sale to the public.
- Improves safety standards in production.
- Workers standards and 'manufacturing pride' increases.
- Customers will gain confidence in the company and brand loyalty and are more likely to buy again.

Credit any other appropriate response.

Question 9

Below are images of two kitchen work surfaces.

Evaluate the environmental advantages and disadvantages of using hardwoods compared to manufactured materials for products such as kitchen work surfaces

Q9	Science	Maths		AO3		AO4					Total
				2b		2a	2b	2c			
	✓			5			4				9

Learners should provide evidence of either appraisal and/or making judgements and applying this to be awarded up to 9 marks based on:

Design The design of the product has an impact on its life cycle and environmental issues.

For example, the manufacturer may choose hardwoods rather than as manufactured materials that can be less durable resulting in the product having a shorter life.

The manufacturer may use manufactured boards to minimize the effect on the environment.

In both cases, it is very difficult to design with “dematerialization” in mind (using less materials) as the work surfaces tend to be the same size requirements.

The use of hardwoods greatly increases the carbon footprint.

Harvesting and Processing The harvesting and logging of hardwoods can have a negative impact on the environment.

The manufacturer will produce pollution when harvesting and will deplete natural resources. Additionally, it causes loss of habitats and can cause land erosion and instability. Transporting hardwoods and global transporting has a detrimental impact on carbon emissions.

The production of manufactured boards can also have an adverse effect on the environment particularly the use of adhesives including urea formaldehyde. Although the production of them are good for the environment due to them being made from wood dust and chippings.

End of Life – reuse, recycling and disposal

Natural hardwoods can be recycled, upcycled or reused. Manufactured boards are less likely to be recycled as they often bonded with resins and glues.

Throwing a product away means that it will end up in a land- fill or incinerator and will not be useful again. Both hardwoods and manufactured boards will decompose over time.

Climate the destruction of forests such as tropical rainforests reduces the ability to take in carbon dioxide. This in turn has a negative effect on the greenhouse effect. A mature forest doesn't necessarily absorb much more CO₂ that it releases, however, because when each tree dies and either rots down or is burned, much of its stored carbon is released once again. In other words, in the context of climate change, the most important thing about mature forests is not that they reduce the amount of CO₂ in the air but that they are huge reservoirs of stored carbon. If such a forest is burned or cleared then much of that carbon is released back into the atmosphere, adding to atmospheric CO₂ levels.

Credit any other appropriate response.

Band	Marks	AO3 2b	Marks	AO4 1c
3	4-5	Excellent evaluation of the advantages and disadvantages of using hardwoods compared to manufactured materials to produce these work surfaces. A thorough discussion that appraises and/or makes judgments. Well-considered, relevant wider issues used as a context for the discussion.	4	Applies a thorough knowledge and understanding of technical principles of environmental issues related to hardwoods and manufactured boards. Well considered, relevant wider issues identified.
		There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.		
2	2-3	Good evaluation of the advantages and disadvantages of using hardwoods compared to manufactured materials to produce these work surfaces A generally sound discussion that appraises and/or makes judgments. Generally well-considered, relevant issues used as a context for the discussion.	2-3	Applies a generally sound knowledge and understanding of technical principles of environmental issues related to hardwoods and manufactured boards. Generally well-considered, relevant issues identified.
		There is a line of reasoning which is generally coherent, mainly relevant and with some evidence and structure.		
1	1	Limited evaluation of the advantages and disadvantages of using hardwoods compared to manufactured materials to produce these work surfaces Little evidence of appraising or making judgments.	1	Applies a basic knowledge and understanding of technical principles of environmental issues related to hardwoods and manufactured boards.
		There is limited evidence of relevant examples or structure.		
	0	No response or work that is worthy of a mark		

Question 10

Ergonomics and anthropometrics play a key role in the design of products such as those shown below

Discuss how ergonomic principles and anthropometric data are used to successfully design effective products

Q10	Science	Maths			AO3		AO4					Total
							1b	1c	2b	2c		
	✓						4		8			12

Learners should demonstrate knowledge and understanding of technical principles and designing and making principles and apply this to be awarded up to 12 marks based on:

Learners could discuss:

When designing a product, designers consider human senses including sight, smell, touch, comfort, sound and temperature. Ergonomics is an applied science concerned with designing and arranging things people use so that the people and things interact most efficiently and safely. Can also be called biotechnology, human engineering, human factors

If a product is ergonomically designed the chances are that it will be a successful product. The user will be able to use the product comfortably. To ensure that products are comfortable and easy to use designers use anthropometric data to make sure that the product is suitable for human use. Anthropometrics is the Science of collecting statistical data about body measurements. Data is collected for Adults and children. Some people are outside of the Average range of body measurements. These are considered to be the 5th and 95th percentile, people who are bigger or smaller than average. The designer invariably designs to the average person.

Specific examples: Iron

The handle of the iron has also changed its angle through time and the design has shifted from being a product made out of exclusive materials into a cleaning product with streamline shape and plastic components.

The positioning of the handle of an iron is vital in order for the iron's centre of gravity, to be in line with the hand and create a homogenous pressing of the fabric.

To give the hand the space it needs and to avoid uncomfortable pressures on sensitive areas as fingers and centre of palm the handle should be larger in order to distribute the pressure evenly on the hand.

When developing products that are used by hand it is of importance to avoid deviation between the wrist and hand in order for the hand to be in a neutral position

Flex needs to be considered to ensure it is designed so the flex cannot get tangled.

Additional features need to be considered including positioning of squeeze buttons, simple colour coding for settings and dials for ease of use. As well as using textures to improve grip.

Controller:

The buttons need to be large enough in width/diameter to facilitate the users. Users with larger fingers will not be able to press the buttons accurately if the buttons are too small for their fingers

The distance between the buttons should be large enough that they can be pressed individually by the users. Users with larger fingers might accidentally hit multiple buttons if they are spaced too close to each other

The maximum movement angle on the analogue sticks should be small enough to allow complete movement for the user. If the maximum movement angle is too large, users with smaller hands will not be able to fully extend the analogue sticks and will be unable to completely control the game

The force required to press the buttons or move the analogue sticks should not be too large for the users. Some users might be unable to use buttons that require more force for extended periods of time without experiencing fatigue.

The affordance: The visual cues and feedback a device provides to allow the user to intuitively know how to use it as intended] of the controller should provide the user with ample information to use the controller as it is intended. This allows the controller to be used in a proper manner and to provide the user with a better experience

Hairdryer

Anthropometric data (measurements) are used to determine the shape of handle and distance to be held from head. Designed for average size hand. The length of lead is determined from anthropometric data (length of average arms and average height of users).

Additional features need to be considered including positioning of squeeze buttons, simple colour coding for settings and dials for ease of use. As well as using textures to improve grip.

Credit any other appropriate response.

Band	Marks	AO4 1b and 1c	Marks	AO4 2b and 2c
3	4	Demonstrates and applies a thorough knowledge and understanding of technical principles related to how ergonomics and anthropometrics can be successfully used to design effective products. Well-considered, relevant wider issues identified.	6-8	Demonstrates and applies a thorough knowledge and understanding of designing and making principles related to ergonomics and anthropometrics, drawing upon well-considered, relevant examples.
		There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.		
2	2-3	Demonstrates and applies a generally sound knowledge and understanding of technical principles related to how ergonomics and anthropometrics can be successfully used to design effective products. Generally well-considered, relevant issues identified.	3-5	Demonstrates and applies a generally sound knowledge and understanding of designing and making principles related to ergonomics and anthropometrics. Generally well-considered examples are provided.
		There is a line of reasoning which is generally coherent, mainly relevant, and with some evidence and structure.		
1	1	Demonstrates and applies a basic knowledge and understanding of technical principles related to how ergonomics and anthropometrics can be successfully used to design effective products. Few issues are identified.	1-2	Demonstrates and applies a basic knowledge and understanding of designing and making principles related ergonomics and anthropometrics. Few examples are provided.
		There is limited evidence of relevant examples or structure.		
	0	No response or work that is worthy of a mark		