GCE AS MARKING SCHEME

SUMMER 2018

AS
DESIGN AND TECHNOLOGY - COMPONENT 1
PRODUCT DESIGN
B602U10-1

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INTRODUCTION

This marking scheme was used by WJEC for the 2018 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.

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EDUQAS GCE AS DESIGN AND TECHNOLOGY - COMPONENT 1

PRODUCT DESIGN

SUMMER 2018 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.

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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.

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SECTION A

Question 1

Modern flat-packed drawer unit.

(a) Describe **two** properties of high-density chipboard that make it appropriate for the drawer unit.

(b) Explain **one** advantage of using knock down fittings in the flat pack drawer unit for the consumer.

(c) Explain **one** feature of effective detail designing.

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

Learners should demonstrate understanding and are awarded up to 4 marks

Award 1 mark for each property of high-density chipboard that makes it appropriate for the drawer unit and one mark for the justification up to a total of 4 marks.

- High Density Chipboard with a veneer surface is cheaper than solid timber [1] therefore reducing the costs to the manufacturer and the consumer [1].
- High Density Chipboard is a rigid board with a relatively smooth surface [1] that is ideal for applying veneer as it requires a smooth surface. [1]
- High Density Chipboard can be easily cut drilled, routed, glued and fastened. [1] therefore making it ideal for flat pack construction and housing knock down fittings [1]
- High Density Chipboard comes in different grades including flame retardant [1] making the product safer to the consumer [1]
- High Density Chipboard comes in different grades including moisture resistant. [1] Making the product more resistant if liquid comes into contact with the surface such as a drink spillage [1]

Credit any other appropriate response.

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				AO3		AO4					
						1a	1b	1c			
1 (b)	✓							2			2

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

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

The product needs a small number of basic tools [1] such as a screwdriver, hammer, and drill making it easier to assemble in the home. [1].
The product can be assembled and reassembled easily [1] as knock down fittings are temporary joints. [1].
Replacement parts are easy for the consumer to purchase [1], as they are readily available in a range of DIY shops.[1]
The use of knock down fittings means that the product can be sold as a flat pack product and assembled at home [1] which makes it easier to transport the product from home to the store. [1]

Credit any other appropriate response.

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

Learners should demonstrate knowledge and are awarded up to 2 marks

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

Features of a detail design : Materials to be used [1], Dimensions and sizes of components [1], Detail of how the product is assembled and put together [1] CAD/CAM drawings [1] Machine settings [1] Final presentation drawing of product [1]

Justification: Make sure that it is possible to make the product [1]. To prepare or purchase equipment or machinery ready for manufacturing [1], Prepare and purchase materials [1], Able to tell the designer if he can foresee any problems with assembly, joining or materials used [1].

Credit any other appropriate response.

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Question 2

Qualitative and quantitative testing is critical to the eventual success of the final product.

Explain:

(a) Explain **one** qualitative test that the designer will carry out during the development of the car.

(b) Explain **one** quantitative test that the manufacturer will carry out during the development of the car.

(c) Explain **two** reasons why manufacturers use their unique logo on products.

(d) The images below show a simple plant pot manufactured in polypropylene.

(i) One plant pot costs £1.52 to manufacture. The manufacturer sells the product to the retailer for £9.99.
Over a period of one month, the manufacturer makes a profit of £1160.39.
Calculate the number of plant pots that have been supplied to the retailer during this month.

(ii) Every time the manufacturer produces 500 or more plant pots the £1.52 per unit manufacturing cost reduces by 1.5%.
Calculate the profit for an order of 8350 plant pots.

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

Learners should demonstrate application of knowledge and understanding and are awarded up to 2 marks.
1 mark for a qualitative test and 1 mark for a justification or supporting reason up to a total of 2 marks.

Qualitative Testing can include test finishes, model shapes, and aesthetics.

The surface finish can be tested [1] to ensure that colour ranges and surface finish appeal and meet the needs of consumers [1].
The shape and form of the car can be tested [1] to help identify potential opportunities and pitfalls in the market [1].
The interior can be tested for comfort and aesthetics [1] to build up an understanding of how different groups of people perceive your product versus other groups [1].

Credit any other appropriate response.

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

Learners should demonstrate application of knowledge and understanding and are awarded up to 2 marks.
1 mark for a quantitative test and 1 mark for a justification or supporting reason up to a total of 2 marks.

Quantitative testing can include material analysis, crash impact and performance related criteria.

The materials can be tested for its properties and mechanical performance [1]. The manufacturer has to ensure that the materials selected will perform under the right conditions and will perform as efficiently as possible [1].
The car should be tested in crash conditions [1] to ensure maximum safety for the consumer. [1]
The car should be tested for emissions [1] to ensure that the car is safe for the consumer and that emissions meet legal requirements [1]

Credit any other appropriate response.

				AO3		AO4					
						1a	1b	1c	2a		
2 (c)						2			2		4

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

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

A unique logo can also be termed registered trademark [TM]. The logo is usually represented graphically [1] to make it easier and quicker for the consumer to recognise it [1].

To distinguish the goods, services of one company from another 1] making it easier for the consumer to recognise products from that manufacturer [1] or; to promote brand loyalty [1]

Intellectual Property - without a registered trademark the company has no legal rights [1] and the idea or logo can be copied or reproduced [1].

Credit any other appropriate response.

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				AO3		AO4					
						1b					
2 (d) i		2				2					2
2 (d) ii		4				4					4

2 (d) (i)
Learners should demonstrate understanding and be awarded up to 2 marks based on:

£9.99 - £1.52 = £8.47 profit per unit ***1 mark***

£1160.39 ÷ 8.47 = 137

Answer = 137 pots sold ***1 mark***

Credit any other appropriate mathematical response.

2 (d) (ii)
Learners should demonstrate understanding and be awarded up to 4 marks based on:

[Working out manufacturing costs after reduction]

(£1.52 ÷ 100) × 1.5 = 0.0228 Calculating the reduction ***1 mark***

1.52 – 0.0228 = £1.4972 (actual cost of each pot manufactured once reduction in place per unit)

Note: Some students round up at this point which is not required.

Costs of Manufacture

£1.4972 × 8350 = £12501.62 [Total Manufacturing Costs] ***1 mark***

Calculating the Revenue

£9.99 × 8350 = £83416.50 ***1 mark***

Calculating Gross Profit = Revenue – Costs

£83416.50 − £12501.62 = £70914.88

Answer = £70914.88 ***1 mark***

Note: if rounded = £70891.51 therefore no mark for incorrect answer.

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Question 3

The image below is of a modern plug socket with USB connection made from urea formaldehyde.

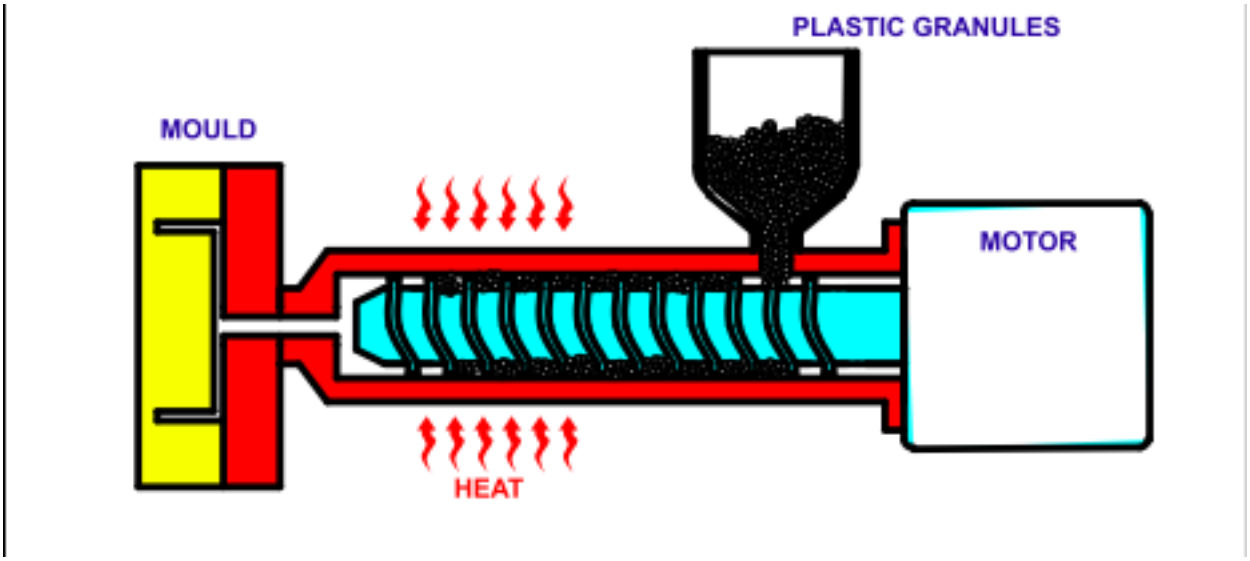
(a) The plug socket has been made by the process of injection moulding.
Use notes and diagrams to describe this process.

(b) Explain **two** properties that make urea formaldehyde a suitable material for the plug socket.

				AO3		AO4						
Q 3	Science	Maths				1a	1b	1c	2a			**Total**
(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.



- Granulated plastic powder is poured into the hopper, which stores them until they are required.
- A heater heats up the tube and when it reaches the required high temperature a screw thread [Archimedes Screw] starts turning as a result of the motor. This pushes the powdered plastic along the screw towards the mould.
- The liquid is forced [injected] into a mould where it cools into the shape
- The mould then opens and the unit is removed.

Credit any other appropriate response.

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(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.

Urea Formaldehyde is scratch resistant [1] it will not be damaged over time and by the pins of the plug [1].
Urea Formaldehyde is an electrical insulator [1], and therefore would be safe in the application of electrical products [1].
Urea Formaldehyde is a thermosetting polymer [1] and will not heat up if there is an electrical fire or short circuit [1].
Urea Formaldehyde can be formed as a very smooth surface [1] resulting in resistance to attracting dust and making it easier to keep clean [1]

Credit any other appropriate response.

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Question 4

The external light product shown below features an acrylic dome hemisphere with a rim.

(a) Explain why acrylic is a suitable material for this product.

(b)

The formula for calculating the surface area of a hemisphere is $A = 2\pi r^2$

(i) Using the formula, calculate the surface area of the dome and the rim in m^2 to 3 decimal places.
Show all calculations.

(ii) The formula $V = \frac{4}{3} \times \pi \times r^3$ is used to calculate the volume of a sphere.

Calculate the volume of the acrylic dome without the rim in mm^3 Rounded to a whole number

Show all calculations.

(c) Describe why vacuum forming could be used to manufacture the acrylic dome.

Q 4	Science	Maths		AO3		AO4					Total
						1a	1b	1c			
4 (a)	✓					2					2
4 (b) i	✓	5						5			5
4 (b) ii	✓	4						4			4
4 (c)							2				2

4 (a) Learners should demonstrate knowledge and are awarded up to 2 marks.
Award 1 mark explaining the purpose and 1 mark for a justification or appropriate supporting comment up to a total of 2 marks.

Acrylic is half the weight of alternative materials such as glass [1] making the product lighter [1]
Acrylic has better impact resistance than other materials such as glass [1] making it more suitable for an exterior light which may be prone to knocks and bumps [1]
Acrylic offers better light transmission than other materials such as polycarbonate [1] and therefore gives better illumination [1]
UV Acrylic protects the product from yellowing and fading caused by UV Light [1] and therefore is more resistant over time to the effects [1]
UV Acrylic tends to have and anti-glare coating [1] which reduces glare and reflections [1]

Credit any other appropriate response.

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4(b) (i) Learners should demonstrate knowledge and understanding and be awarded up to 5 marks based on:

Find Surface Area of the Hemisphere

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

=2 x π x 300 ^{2}

Answer =565486.6776mm 1 Mark

Find Surface Area of Rim
= π x 350^2 - π x 300^2
= 384845.1001 – 282743.3388

Answer = 102101.7612 mm^2

Accept rounding to a sensible degree of accuracy e.g. 102102 mm^2 1 Mark

Find Total Surface Area

Add them together
565486.6776 + 102101.7612
= 667588.4389mm ^{2} 1 Mark

Convert mm^2 to m^2
667588.4389mm ^{2} ÷ 1000000 or 10^6 1 Mark

0.6675884389 m^2
Accept rounding to a sensible degree of accuracy e.g.0.668 m^2 1 Mark

Do not penalise for any errors carried forward. Continue to award marks if you can clearly see the mathematical method used by the candidate.

4b (ii) Volume of dome
Learners should demonstrate knowledge and understanding and be awarded up to 4 marks based on:

Changing the given formula from a sphere to a hemisphere
$\frac{2}{3} \times \pi \times 300^3$ 1 Mark
External volume of dome - Internal volume of dome

$\frac{2}{3} \times \pi \times 300^3 - \frac{2}{3} \times \pi \times 294^3$ Applying the formula 1 Mark

= 56548667.76 – 53223153.71

Answer
= 3325514.05 mm^3 1 Mark

Accept rounding to a sensible degree of accuracy
e.g. 3325514mm^3 1 Mark

Do not penalise for any errors carried forward. Continue to award marks if you can clearly see the mathematical method used by the candidate.

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4(c) 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.

Vacuum Forming is a simplified version of thermoforming.

- A sheet of thermoplastic is heated and softened and then stretched onto a single-surface mould [1] making it ideal for the dome as it is half a hemisphere and a single surface mould can be used [1].
- Usually draft angles are present [1] to allow the mould to be released. [1]
- Cast aluminium moulds typically have temperature control lines running through them. [1] This helps to set the heat of the plastic being formed as well as speed up the fabrication process. [1]
- Relatively deep parts can be formed if the acrylic is mechanically or pneumatically stretched prior to pressure forming [1] allowing for more complex designs to be manufactured [1]

Credit any other appropriate response.

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Question 5

(a) Explain the meaning of the term Just in Time manufacturing (JIT).

(b) The design of the packaging has a significant impact on the success of a product.

(i) Describe **two** reasons why a company would conduct consumer market research when developing packaging for a new mobile phone.

(ii) Smart Materials such as thermochromic inks are widely used in the packaging of food and drink products such as the drinks cans below.

Describe **two** advantages of using thermochromic inks in product packaging to the consumer.

				AO3		AO4					
Q 5	Science	Maths				1a	1b	1c			**Total**
5 (a)						2					2
(b) i							4				4
(b) ii							4				4

5(a) Learners should demonstrate knowledge and are awarded up to 2 marks.

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

A production method where materials and components arrive just before the product is manufactured [1] to reduce the amount of warehouse and floor area required for stock [1], to limit the amount of money tied up in stock [1] to enable the manufacturer to change a product quickly.1].

Credit any other appropriate response.

5(b) (i) Learners should demonstrate understanding and be awarded 4 marks

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

- 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].
- 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]
- Consumer market research can effectively identify the purchase interests of a target group [1] so that packaging design can appeal to them to ensure that they choose that product [1]
- Consumer market research can analyse the effectiveness of packaging design such as layouts/Logos/Trademarks [1] so that the designer can ensure the packaging appeals to the consumer [1] fits in with the compatibility of the brand [1]

Credit any other appropriate response.

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5b(ii) Learners should demonstrate understanding and be awarded 4 marks

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

Thermochromic inks are used in packaging and labels for refrigerated items. [1] Traditionally used for providing functional information to the consumer such as the product is too warm. [1]

Thermochromic inks provide packaging with fun, playful interaction between the consumer and the brand [1] therefore providing better consumer satisfaction. [1]

Thermochromic inks can be used to encourage consumers to store their products properly such as a competition revealing itself when stored in the refrigerator. [1] This can educate and change the behaviour of consumers to ensure food/drink does not go off as it is stored correctly. [1]

Thermochromic inks are based on leuco dyes are very easy to apply with practically no difference to other packaging inks [1] therefore do not cost a significant amount more to apply on products. This keeps the cost down for the consumer [1]

Credit any other appropriate response.

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Question 6

The CE mark is often found on packaging such as the LED Bulb shown below.

Explain how the CE mark protects the consumer when purchasing a LED bulb.

	Science	Maths		AO3	AO4					Total
					1a	1b	1c	2a	2b	
									5	5

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

CE Marking 'Conformité Européene'

CE marking helps to support basic consumer rights, such as the right to safety and the right to be informed [1]
CE marking is the manufacturer's declaration that the product meets the requirements of the applicable EC directives [1] and as such helps support basic consumer protection [1] helps to raise levels of quality, safety, reliability in products which is better for the consumer .[1]

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 [1] this protects the consumer in terms of legal protection and litigation for damages. [1]
The application of CE marking for LED products covers electrical safety [1]

- 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. [1]
Consumers can make better purchase decisions by looking for the marking and not purchasing products without the marking [1]

Credit any other appropriate response.

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Question 7

Manufacturers often use standardised parts when manufacturing and assembling products such as the bike shown below.

(a) Analyse the advantages and disadvantages of using standardised parts in the design and production of a mountain bike to the manufacturer.

(b) Evaluate how the use of stock forms of hardwoods, softwoods and manufactured boards affect the manufacturer and the consumer.

Q7	Science	Maths		AO3		AO4					Total
				2a	2b	1c	2a	2b	2c		
(a)				4					2		6
(b)					4	2					6

7 (a) 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.

To reduce staffing, machinery, and costs companies do not make all their own parts. They buy in standardised parts or part assembled components to assemble and create the final product.

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.

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Band	Marks	AO3 2a	Marks	AO4 2c
2	**3-4**	Good analysis of the advantages and disadvantages of using standardised parts in manufacturing and assembly. 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	**2**	Applies a sound knowledge and understanding of designing and making principles to the context of using standardised parts in manufacturing and assembly
		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 advantages and disadvantages of using standardised parts in manufacturing and assembly. Little evidence of deconstructing information and limited connections are made. Few factors are identified.	**1**	Applies a basic knowledge and understanding of designing and making principles to the context of using standardised parts in manufacturing and assembly
		There is limited evidence of relevant examples or structure.		
	0	No response or work that is worthy of a mark		

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7 (b) Candidates should show clear evidence of appraisal and/or making judgements and then apply this to technical principles to be awarded up to 6 marks.

Issues that the learner could be discussing:

Advantages to the Manufacturer:

- 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
- Standard forms and sizes are generally the same in most countries [international standard] and therefore promote global production

Advantages to the Consumer:

- The net reduction in costs in using standard forms to the manufacturer can be passed onto the consumer and therefore lead to lower prices for products.
- Standard forms and sizes are cheaper than special sizes.
- Many standard form and sizes are good for the environment as the manufacturer can calculate how to get the most material from the tree including using waste products to make manufactured boards

Disadvantages:

- The consumer sometimes has to purchase more material than required because it is sold as a certain stock size
- The consumer may have difficulty transporting certain stock sizes such as 2440mm x 1220mm manufactured board unless it is cut into more convenient sizing
- There can sometimes a lack of variety in terms of range and sizing of certain timbers
- Bespoke sizes outside of standard form and sizes can be difficult to source and expensive for consumers.

Credit any other appropriate response.

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Band	Marks	AO3 2b	Marks	AO4 1c
2	**3-4**	Good evaluation of how stock forms and sizes affect the manufacturer and the consumer. A sound discussion which appraises and/or makes judgements about how stock forms and sizes affect the manufacturer and the consumer. Generally well-considered, relevant issues used as a context for the discussion.	**2**	Applies a sound knowledge and understanding of technical principles to the context of how stock forms and sizes affect the manufacturer and the consumer. 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	**1-2**	Limited evaluation of how stock forms and sizes affect the manufacturer and the consumer. Little evidence of appraising or making judgements about how stock forms and sizes affect the manufacturer and the consumer.	**1**	Applies a basic knowledge and understanding of technical principles to the context of how stock forms and sizes affect the manufacturer and the consumer.
		There is limited evidence of relevant examples or structure.		
	0	No response or work that is worthy of a mark		

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Question 8

Quality control and quality assurance are critical to ensure the successful manufacture and sale of a new product.

Analyse the role that quality control and quality assurance play in the success of a new product, such as the vacuum cleaner shown.

Q8	Science	Maths		AO3		AO4					Total
				2a		2a	2b	2c			
				6				3			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.

Benefits to the consumer:

- Would be assured of the quality and know the product is safe to use.
- Encourages repeat buying from the same company.
- Can hold someone to account if it goes wrong.

Credit any other appropriate response.

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Band	Marks	AO3 2a	Marks	AO4 2c
3	**5-6**	Excellent analysis of the role of QC and QA to ensure success to a manufacturer. A thorough discussion, which deconstructs information and demonstrates logical connections and reasoning throughout. Well-considered, relevant examples used to support the discussion.	**3**	Applies a thorough knowledge and understanding of designing and making principles to illustrate, with well-considered, relevant examples, how QC & QA ensures success to a manufacturer.
		There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.		
2	**3-4**	Good analysis of the role of QC and QA to ensure success to a manufacturer. A generally sound discussion, which deconstructs information and provides adequate connections and reasoning throughout. Generally well-considered, relevant examples used to support the discussion.	**2**	Applies a generally sound knowledge and understanding of designing and making principles to illustrate, with generally well-considered examples, how QC & QA ensures success to a manufacturer.
		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 role of QC & QA to ensure success to a manufacturer. Little evidence of deconstructing information and limited connections are made. Few examples used to support the discussion.	**1**	Applies a basic knowledge and understanding of designing and making principles to partly demonstrate, with limited exemplification, how QC & QA ensures success to a manufacturer.
		There is limited evidence of relevant examples or structure.		
	0	No response or work that is worthy of a mark		

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Question 9

Many companies now utilise the benefits of global production when manufacturing products where different parts, components or materials are sourced internationally.

Evaluate the economic and environmental effects of global production.

	Science	Maths		AO3		AO4					Total
				2b		2a	2b	2c			
	✓			6				3			9

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

Globalisation means that there is free movement of products, services and capital across the borders of the world, helping the world economy to grow.
The world's modern transport and communication infrastructure has enabled the growth of globalisation.
In simple terms a product may be designed in one country, with the manufacture of component parts and final assembly taking place in a number of countries across the world. The marketplace for the product may also be international.
Multi-national companies tend to work globally taking advantage of interest rates, currency rates, cheap labour and labour skills across the world.

Advantages of globalisation:

- Cheaper products
- Increased availability and variety of products.
- Flow of technical skills across the world enabling companies to fill skill gaps.
- Increased trade and corresponding economic development and growth.
- Flow of education and ideas.

Disadvantages of globalisation:

- As companies chase increased profits, the movement to cheaper labour or the relocation of production can lead to unemployment in other areas.
- Increased pollution and environmental damage, as more and more natural resources are used and as industrial and agricultural needs are focussed in certain parts of the world.
- Transport of goods and parts can increase pollution such as the use of container ships.
- Companies can relocate production to parts of the world where environmental regulations are more lenient.
- Companies can relocate production to where labour is cheaper; health and safety regulations are more lenient which in turn can lead to poorer working conditions.

Credit any other appropriate response.

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Band	Marks	AO3 2b	Marks	AO4 2c
3	**5-6**	Excellent evaluation of the economic and environmental issues of globalisation. A thorough discussion which appraises and/or makes judgements about the economic and environmental issues of globalisation. Well-considered, relevant wider issues used as a context for the discussion.	**3**	Applies a thorough knowledge and understanding of technical principles to the context of economic and environmental issues of globalisation. Well-considered, relevant wider issues identified.
		There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.		
2	**3-4**	Good evaluation of the economic and environmental issues of globalisation. A generally sound discussion which appraises and/or makes judgements about the economic and environmental issues of globalisation. Generally well-considered, relevant issues used as a context for the discussion.	**2**	Applies a generally sound knowledge and understanding of technical principles to the context of economic and environmental issues of globalisation. 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	**1-2**	Limited evaluation of the economic and environmental issues of globalisation. Little evidence of appraising or making judgements about the economic and environmental issues of globalisation.	**1**	Applies a basic knowledge and understanding of technical principles to the context of economic and environmental issues of globalisation.
		There is limited evidence of relevant examples or structure.		
	0	No response or work that is worthy of a mark		

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Question 10

Modern sports equipment such as hockey sticks, tennis rackets, cycles and golf clubs are made using composite materials such as fibreglass, Kevlar and Carbon Fibre Weave.

Describe the advantages and disadvantages of using composite materials in the design of modern sports equipment.

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

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.
The resins start as a liquid and polymerize during the cure process and harden.
The weight ratio of fibres to resin can range from 20% fibres to 80% resin to 70% fibres to 30% resin. Typically the higher fibre content provides even better strength and stiffness, and continuous fibres provide better strength and stiffness.

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

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 sports equipment.
- 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.

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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 body armour but is widely used in various sports equipment.

- Very strong but also flexible allowing better performance of sports equipment. It is strong and tough because the molecules can pack closely together.
- Very resistant to impact and abrasion damage making it ideal for sports products requiring force often at high speeds such as a hockey stick hitting a hard ball.
- It can be made waterproof when combined with other materials like epoxy.
- It can be used with rubber as a composite to increase the flexibility of the sports equipment.

Carbon Fibre Weave
Advantages for use on Sports equipment: 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 making them ideal for sports equipment. The larger the ratio of carbon fibre weave the lighter the sports equipment.
- 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 sports equipment.

- Carbon Fibre is the material used to create the stiffness in sports equipment, the more carbon fibre the stiffer it is, which in turn leads to the greatest amount of power being transferred from the stick to the ball.
- 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.

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Band	Marks	AO4 1b and 1c	Marks	AO4 2b and 2c
3	**6-8**	Demonstrates and applies a thorough knowledge and understanding of technical principles related to the use of composite materials in the design and manufacture of sports equipment. Well-considered, relevant wider issues identified.	**4**	Demonstrates and applies a thorough knowledge and understanding of designing and making principles related to composites, drawing upon well-considered, relevant examples.
		There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.		
2	**3-5**	Demonstrates and applies a generally sound knowledge and understanding of technical principles related to the use of composite materials in the design and manufacture of sports equipment. Generally well-considered, relevant issues identified.	**3**	Demonstrates and applies a generally sound knowledge and understanding of designing and making principles related to composites. 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	**1-2**	Demonstrates and applies a basic knowledge and understanding of technical principles related to the use of composite materials in the design and manufacture of sports equipment. Few issues are identified.	**1**	Demonstrates and applies a basic knowledge and understanding of designing and making principles related to composites. Few examples are provided.
		There is limited evidence of relevant examples or structure.		
	0	No response or work that is worthy of a mark		

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