

GCE A LEVEL



WJEC Eduqas GCE A Level in DESIGN AND TECHNOLOGY

ACCREDITED BY OFQUAL

SAMPLE ASSESSMENT MATERIALS

Teaching from 2017



This Ofqual regulated qualification is not available for candidates in maintained schools and colleges in Wales.



For teaching from 2017
For award from 2019

GCE A LEVEL DESIGN AND TECHNOLOGY

SAMPLE ASSESSMENT MATERIALS

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A LEVEL
DESIGN AND TECHNOLOGY
COMPONENT 1
Fashion and Textiles
SAMPLE ASSESSMENT MATERIALS
Duration 3 Hours



ADDITIONAL MATERIALS

In addition to this examination paper you will need an answer book.

INSTRUCTIONS TO CANDIDATES

Answer **all** questions

Use black ink or black ball-point pen.

Do not use pencil or gel pen.

Do not use correction fluid.

INFORMATION FOR CANDIDATES

When and where appropriate, answers should be amplified and illustrated with sketches and/or diagrams.

The number of marks is given in brackets at the end of each question or part-question. You are advised to divide your time accordingly.

The number of marks available is 100.

You are reminded of the need for good English and orderly, clear presentation in your answers.

You may use a calculator in this examination.

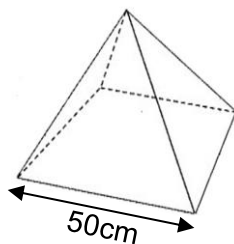
1. Developments in material technology have led to the introduction of SMART materials.

- (a) Explain what is meant by the term SMART material, using a textile product to exemplify your answer. [2]
- (b) Explain how the process of micro-encapsulation works and describe its impact in medical textiles. [6]

2. Soft play shapes like the ones pictured below are made from PU coated nylon.



- (a) Explain how the properties of PU coated nylon make it a suitable material for the soft play shapes. [4]
- (b) Using notes and sketches, describe a method of reinforcing the seams on the soft play shapes. [4]
- (c) (i) The designer has included a new pyramid style shape as shown. Calculate, to one decimal place, the height of the pyramid. [4]
Show all calculations.
- (ii) Calculate, to one decimal place, the surface area of one of the sides of the pyramid. [2]
Show all calculations.



- The square base of the pyramid shape is 50cm.
- The sides are all equilateral triangles.

3. Study the picture of a ladies quilted jacket shown below and answer the questions that follow.



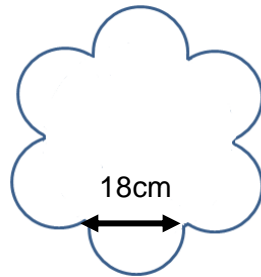
Product details

Outer material: Polyester
Lining: 100% Nylon
Inner lining: Polyester fibrefill

- (a) The jacket has been quilted which helps keep the wearer warm during the cold weather.
Explain how the designer could improve the jacket's insulating qualities. [4]
- (b) Describe an appropriate method of comparing the insulating qualities of different textile materials. *Use notes and diagrams to illustrate your answer.* [4]
4. Textile products are made in different scales of production.
- (a) Explain why batch production has been used to manufacture the flower shaped cushion pad shown below, to be used in children's nurseries. [4]



- (b) Piping has been used to reinforce the scalloped edges of the cushion pad on both sides of the pad.



The outer edge of the template is made up of six equal sized semi-circular shapes, each with a diameter of 18cm as shown opposite.

Calculate the quantity of piping needed to make one cushion pad and the surface area of the template. [6]
Show all calculations.

- (c) The pink spotted material used for the top and bottom of the cushion pad is available in two widths: 115cm wide @ £3.20 per metre and 90cm wide @ £2.45 per metre.

Each cushion is to be cut out of a 38cm square.

Calculate the most cost effective width of material for the manufacturer to use to make 6 cushion pads. [3]
Show all calculations.

5. The picture below shows a 1950's inspired summer dress.



- (a) Explain how historical influences play a major role in the development of contemporary fashion like the summer dress shown. [5]
- (b) Explain how a disassembly of an original 1950's dress could support a designer in the development of the contemporary summer dress. [5]

6. The sports shoe pictured below contains an insole made from memory foam which was originally developed for use in aircraft and later, most notably used for mattresses.



Describe how 'market-pull' has impacted on the design and development of this style of sports shoe to include a material not previously developed for this purpose. [5]

7. Consumers need to be confident that the textile products they buy are safe and fit for purpose.

- (a) Analyse and describe two tests a designer would need to consider when designing children's soft toys like the teddy bear pictured below. [6]



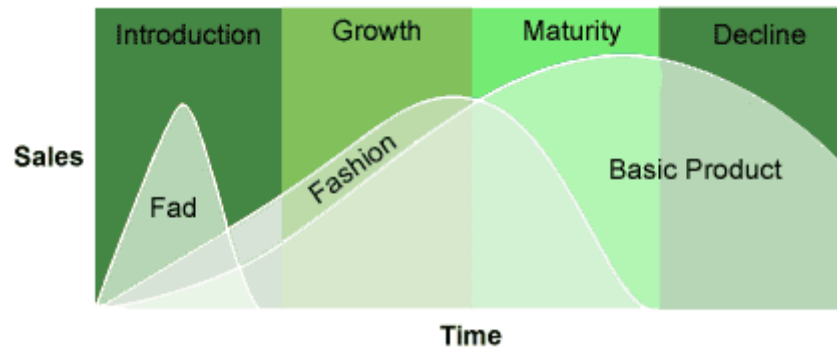
- (b) Evaluate the work of the BSI in protecting consumer confidence. Exemplify your answer. [6]

8. The commercial aspect of the fashion industry is having a major impact on the environment. We are living in what is considered a 'throw away' society.

Analyse the impact this practice is having on the environment and give examples of how fashion designers could help alleviate this problem. [9]

9. Explain how the application of computer aided design (CAD) and computer aided manufacture (CAM) has impacted on the manufacturing industry for mass produced fashionable clothing. [9]

10. Product cycle graphs like the one shown below are often used by fashion buyers.



Evaluate the use of product cycle graphs by fashion buyers, on behalf of fashion retailers and manufacturers when planning and developing new products. [12]

COMPONENT 1

A level Design and Technology – Fashion and Textiles

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.

Question 1

- (a) Explain what is meant by the term SMART material using a textile product to exemplify your answer.
- (b) Explain how the process of micro-encapsulation works and describe its impact in medical textiles.

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

An explanation that includes an understanding of a SMART material [1] and [1] for an appropriate textile product.

Candidates should demonstrate knowledge and be awarded up to 2 marks based on:

- A smart material reacts to external stimuli and/or changes in its environment – light, temperature, moisture or pressure [1] e.g. T-shirt that reacts to body heat [1].

Credit any other appropriate response.

1 (b)	✓					4	2		6
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An explanation of micro encapsulation and how it works [4] and a description of its use in medical textiles [2].

Candidates should demonstrate understanding and be awarded up to 4 marks based on:
 Micro-encapsulation: microscopic droplets are applied to either a yarn or material/microfibre in a dressing for a wound [1]; the microscopic droplets can contain a number of beneficial substances such as vitamins or oils or aromatic chemicals [1]; the chemicals or substances are gradually released when in direct contact with skin [1] or through pressure [1] or friction [1].

Candidates should demonstrate application of knowledge and understanding and be awarded up to 2 marks based on:

In medical textiles microencapsulation of antiseptics is used on bandages, wound dressings and medical stitches [1]; antiseptic released slowly over a period of time eliminates the needs to keep changing dressings therefore reducing the chances of infection [1].

Credit any other appropriate response.

Question 2

- (a) Explain how the properties of PU coated nylon make it a suitable material for the soft play shapes.
- (b) Using notes and sketches, describe a method of reinforcing the seams on the soft play shapes.
- (c) (i) The designer has included a new pyramid style shape as shown. Calculate the height of the pyramid.
- (ii) Calculate the surface area of one of the sides of the pyramid.
- Your answers must be to one decimal place.

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

Candidates should demonstrate knowledge. 1 mark for each appropriate response.

- PU coating enables the soft play shapes to be wiped/washed down [1].
- Nylon helps ensure the soft play shapes are hardwearing/durable [1].

Candidates should apply knowledge and understanding and be awarded up to 2 marks based on:

- Soft play shapes subjected to rough play with children climbing on them, jumping on them, throwing them [1] – materials need to be durable and long lasting [1];
- Soft play shapes need to be easily maintained [1] – wiped clean/ hygiene reasons [1].

Credit any other appropriate response.

2 (b)						2		2		4
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Candidates should demonstrate knowledge and understanding and its application in this context to be awarded up to 4 marks.

If a candidate does not use sketches to exemplify the answer award up to a max 3 marks. If a candidate does not include notes but has appropriate labelled sketches award up to a max 3 marks.

Notes and sketches should make reference to the following seams as the most suitable: double stitched seam; flat fell seam; bound seam.

Example - Double-stitch - look for four basic stages.

The two pieces are placed back to back [1] - then a row is stitched [1] - the fabric is then folded out flat [1] and the seam folded over for the second seam of stitches [1].

Credit any other appropriate response.

2 (c)		6				2	4			6
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(i) To calculate the height of the pyramid, the candidate will need to calculate the distance between the corners of the base pyramid.

$$H^2 = a^2 + b^2$$

$$H^2 = 50^2 + 50^2 \quad 1 \text{ mark}$$

$$H = \sqrt{50sq + 50sq}$$

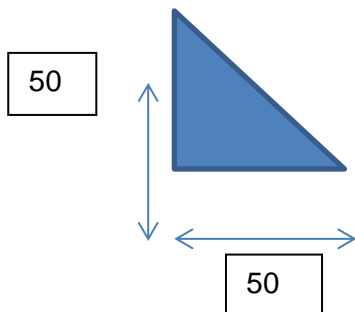
$$H = 70.7 \text{ cm} \quad 1 \text{ mark}$$

Height of the pyramid

$$H^2 = a^2 + b^2$$

$$A = 50^2 - (70.7/2)^2 \quad 1 \text{ mark}$$

$$A = 35.3 \text{ cm} \quad 1 \text{ mark}$$



SOHCAHTOA method for height of Pyramid

$$\text{Cos} = \frac{35.36}{50}$$

$$\text{Cos} = 45^\circ \quad 1 \text{ mark}$$

$$\text{Sine } 45 = \frac{\text{opp}}{50}$$

$$\text{Height} = 35.3 \text{ cm} \quad 1 \text{ mark}$$

(ii) To calculate the surface area of one side of the pyramid...

$$\text{Surface Area} = \frac{\sqrt{3}}{4} \times 50^2 \quad 1 \text{ mark}$$

$$= 1082.5 \text{ cm} \quad 1 \text{ mark}$$

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

Credit any other appropriate response.

Question 3

- (a) The jacket has been quilted which helps keep the wearer warm during the cold weather.
Explain how the designer could improve the jacket's insulating qualities.
- (b) Describe an appropriate method of comparing the insulating qualities of different textile materials. *Use notes and diagrams to illustrate your answer.*

Q 3	Science	Maths	AO3		AO4				Total
			2a	2b	1a	1b	1c	2a	
3 (a)	✓							4	4

1 mark for each appropriate response that clearly indicates how the jacket's insulating qualities could be improved up to a total of 4 marks.

To improve insulation the separate materials can be changed [1]; the outer layer could be a laminate [1]; a thicker named material [1]; dense weave nylon which does not allow wind to penetrate [1]; the inner layer could be 'down' which has better thermal qualities than fibrefill wadding [1]; thicker/more dense wadding would provide more insulation [1]; the lining could be a brushed material that traps more warmth or a named material that has better insulating qualities than nylon [1].

Credit any other appropriate response.

3 (b)	✓				4				4
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If a candidate does not use diagrams to exemplify the answer award up to a max of 3 marks. If a candidate does not include notes but has appropriate labelled diagrams award up to a max of 3 marks.

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

- 'Socks' in different materials to be tested are fitted over test tubes [1].
- Hot water (at a set temperature) is poured into each test-tube and capped off with a rubber stopper which has a thermometer through it that goes into the water [1].
- After a set length of time, the material sock that is the most insulating and thermally efficient will keep the water temperature closest to the starting temperature of the water [1]. Candidates should state that results need to be compared.
- Test tube with lowest temperature on the thermometer has the least insulating material sock [1].

Credit any appropriate response that compares the insulating qualities of textiles materials.

Question 4

- (a) Explain why batch production has been used to manufacture the flower shaped cushion pad shown below to be used in children's nurseries.
- (b) Piping has been used to reinforce the scalloped edges of the cushion pad on both sides of the pad.
Calculate the quantity of piping needed to make one cushion pad and the surface area of the template.
Show all calculations.
- (c) Calculate the most cost effective width of material for the manufacturer to use to make 6 cushion pads.
Show all calculations.

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

The answer must show an understanding of batch production, 1 mark for all points that have been explained.

Possible limited appeal of the product due to unusual shape/colour choice/ pattern [1]; fashion and trends change so limits demand [1]; complex shape with detailing not appropriate for mass production requires more skill in construction and machine skills of workforce [1]. Made in smaller batches in different colours / patterns so smaller batches make economic sense [1]. May be seasonal demand in different colourways [1].

Credit any other appropriate response.

4 (b)		6					6		6
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Candidates should apply knowledge and understanding and are awarded up to 6 marks based on:

- Calculation for one arc on the semicircle: πr
 $3.142 \times 9\text{cm}$ ($\frac{1}{2} 18\text{cm}$) (π could be $\frac{22}{7}$)
 Answer: 28.278 cm for one arc of semicircle **1 mark**

Answer: 339.34cm (accept 340cm) or 3.40m **1 mark**

Surface area of the template
 $(3.142 \times 18^2) \times 3 = 1018 \text{ cm}^2$ **1 mark**

Realisation that the shape is made up of 6 triangles **1 mark**

Surface area of the hexagonal shape = $6 \times \frac{\sqrt{3}}{4} \times 18^2 = 841.8 \text{ cm}^2$ **1 mark**

Total area = $1018 + 841.8 = 1859.8 \text{ cm}^2$ **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.

Credit any other appropriate mathematical response.

4 (c)		3					3			3
<p>Candidates should apply knowledge and understanding and are awarded up to 3 marks based on:</p> <p>Working out the material utilisation on both widths of material for 6 cushions –</p> <ul style="list-style-type: none"> • <u>On 115cm</u>: 3 panels will fit across the width – (1.5 cushions) <ul style="list-style-type: none"> 38cm (widest points) x 4 (for 6 cushions) = 1.52m material 1.52 x £3.20 = £4.87 on 115cm wide 1 mark • <u>On 90cm</u>: 2 panels will fit across the width – (1 cushion) <ul style="list-style-type: none"> 38 cm at widest point x 6 = 2.28m material 2.28 x £2.45 = £5.59 on 90cms wide 1 mark • Answer: 115cms wide is the most cost effective width. 1 mark <p>Do not penalise for any errors carried forward. Continue to award marks if you can clearly see the mathematical method used by the candidate.</p> <p>All calculations must be clearly shown.</p> <p><i>Credit any other mathematical appropriate response.</i></p>										

Question 5

- (a) Explain how historical influences play a major role in the development of contemporary fashion like the summer dress shown.
- (b) Explain how a disassembly of an original 1950's dress could support a designer in the development of the contemporary summer dress.

Q 5	Science	Maths	AO3		AO4				Total	
			2a	2b	1a	1b	1c			
5 (a)					2	3				5

Candidates should demonstrate knowledge and understanding and are awarded up to 5 marks.

Designers tend to refer to historical fashion trends for various reasons which impact on contemporary trends [1] for example: to source ideas and gain inspiration [1]; ideas could come from shape and style of garments/style details [1]; pattern cutting techniques [1] prints and pattern on textiles – styles associated with particular designers linked to art movements or specific periods in history [1]; popular movements in fashion history – reinvention of ideas [1]; materials used historically and why [1]; the silhouette of the 1950s is as popular today as originally – accentuates a ‘nipped in’ slim waistline [1]; the concept that nothing is new but a re-invention of past ideas and trends [1].

Credit any other appropriate response.

5 (b)						5				5
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Candidates should demonstrate understanding and are awarded up to 5 marks.

Knowledge of a disassembly activity – deconstruction of the dress either physically or virtually [1]; to gain a better understanding of how the dress has been put together [1] and to use this information either to get an identical fit to the original [1] or to improve on the fit of the original [1]; to understand the construction techniques used in the original dress [1] and to replicate it as closely as possible so that it looks authentic [1]; to develop pattern templates for the contemporary dress [1].

Credit any other appropriate response.

Question 6

The sports shoe pictured below contains an insole made from memory foam which was originally developed for use in aircraft and later, most notably used for mattresses.

Describe how 'market-pull' has impacted on the design and development of this style of sports shoe to include a material not previously developed for this purpose.

Q 6	Science	Maths	AO3		AO4				Total
			2a	2b	2a	2b	2c		
						5			5

Candidates should demonstrate understanding of designing and making principles relating to market pull and are awarded up to 5 marks based on:

Description of how market pull has impacted on the sports shoe – ideas for new products come from a demand from society or a specific section of the market [1]; a 'need' for particular type of footwear has been identified though market research [1]; existing products don't meet the need so a new product is needed or a development on an existing product is needed [1]; the material technology (memory foam) exists to meet the need in this case comfort and support in sports footwear, it is also lightweight [1]; as the material moulds to the shape of the foot it provides the necessary comfort and support, it is also lightweight, that the initial market research identified as a 'need' – product development – has led to the development of this sports shoe [1].

Credit any other appropriate response.

Question 7

(a) Consumers need to be confident that the textile products they buy are safe and fit for purpose.

Analyse and describe two tests a designer would need to consider when designing children’s soft toys like the teddy bear pictured below.

(b) Evaluate the work of the BSI in protecting consumer confidence. Exemplify your answer.

Q 7	Science	Maths	AO3		AO4			Total	
			2a	2b	1b	1c	2a		2b
7(a)			4					2	6

Candidates should show evidence of *logical reasoning* or *deconstructing information* and *applying* this to be awarded up to 6 marks.

The question refers to two tests. The maximum mark per test is three – two marks for analysis and one for application to the context of the teddy bear.

Typical tests for the teddy bear could include:

- The designer would need to consider a test that ensures a child could not easily detach an eye from the teddy bear, potentially creating a choking hazard [1]. This could be achieved by applying a force to the eye(s), by tugging at the eyes or attaching heavy weights to them, to simulate the action of a child pulling on the eye(s) [1]. The designer would need to consider the typical force with which a child might pull at the eye(s) to ensure that the test is a reflection of real life [1].
- The designer would need to consider a test that measures the flammability of the material from which the teddy bear is made, in case a child holds or drops the toy near a heat source [1]. The teddy bear would be subject to an ignition source under controlled conditions and the degree of flame resistance assessed/timed [1]. The outcome of the flammability test would be compared with regulatory ratings (BSI) to ensure the toy meets regulatory requirements.
- The designer would need to consider a test that measures the durability of the material from which the teddy bear is made, including its resistance to fibres becoming detached, potentially creating a choking hazard [1]. This could be achieved by rubbing the material in controlled conditions and assessing the extent to which fibres withstand the test without breaking/becoming detached [1]. (Note – the candidate could refer to a change in colour/shade if they are responding from an aesthetic perspective.) The designer would need to consider the likely deterioration in the material(s) over time in use by a child to ensure appropriate durability (or appearance retention) [1].
- The designer would need to consider a test that ensures a child could not easily detach a limb from the teddy bear, potentially creating a choking hazard [1]. This could be achieved by applying a force to the arms and legs by tugging at the limbs or twisting them back and forth, to simulate the action of a child pulling on the limbs and ensure the joints/mechanism is fit for purpose [1]. The designer would need to consider the typical force with which a child might pull at the limbs, and any twisting action, to ensure that the test is a reflection of real life [1].

Credit any other appropriate response.

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

Candidates should show clear evidence of appraisal and/or making judgements and applying this to technical principles to be awarded up to 6 marks.

Candidates may make reference to other standards - 1 mark for each point that has been justified up to a total of 6 marks.

Product safety is a matter of law. Products have to meet standards that are specific to the type of product. BSI covers a wide range of standards, standardisation and quality assurance. Consumers can be assured that products are fit for purpose in all aspects and safe.

Candidates could make reference to:

- BSI sets the standards for a wide range of products including textile products [1].
- Legislation is in place to protect consumer rights [1].
- BSI tests products and the processes used to make them [1]. If the product meets the standard then the manufacturer can display, for example, the Kitemark [1].
- Consumers trust the Kitemark and are assured of its safety [1] – product will have gone through rigorous testing [1].
- Flammability tests – related to children’s nightwear and baby garments have to carry a label stating they have met certain regulations relating to flammability [1].
- CE labelling conforms to certain EU laws – can be sold anywhere in Europe [1].
- Lion mark – toy safety laws from BTHA [1]
- Furniture and Furnishings (Fire safety) regulations - refers to all furnishings, for example, curtains, settees and loose furnishings are required to be resistant to ‘smouldering from cigarette ignition’ [1].
- BEAB – on electrical goods [1].
- Standards are set for textile components – fit for purpose and safe [1].
- Standards relating to finishes applied to textiles such as colour fastness, shrinkage [1].

Credit any other appropriate response.

Question 8

The commercial aspect of the fashion industry is having a major impact on the environment. We are living in what is considered a ‘throw away’ society.

Analyse the impact this practice is having on the environment and give examples of how fashion designers could help alleviate this problem.

Q 8	Science	Maths	AO3		AO4			Total	
			2a	2b	1b	1c	2a		2b
			6					3	9

Candidates should provide evidence of *logical reasoning* or *deconstructing information* and *applying* this to be awarded up to 9 marks.

- Demand for cheap clothing/products – manufactured in third world/poorer countries, labour costs are lower – commercial aspect adds to problems.
- Cheap products consumers don't care/don't think about the wider issues – the desire for latest fashions overrides the issues.
- Products going to landfill – disposal – decompose/do not decompose and the impact of both.
- Use of finite resources - shortages, impact on future generations.
- Globalisation – carbon footprint – materials and components sourced and manufactured globally – then onto markets.
- Pollution from factories (in all aspects of the manufacturing industry): gases into atmosphere, land or waterways, dyes, chemicals in various processes.
- Products are easier to replace rather than repair.

Designers could consider:

- The importance of designing and making products that last – better quality and are easily repaired.
- Use of sustainable materials – or use recycled materials.
- Using materials that are easily recycled and reprocessed.
- Fair trade suppliers/manufacturers.
- Advertising more effectively about the product's green credentials.
- Products that could be adapted or up-cycled into new.
- Source materials and components closer to location of factory and market place.
- Use greener/renewable energy to power factories.

Credit any other appropriate response.

Band	Marks	AO3 2a	Marks	AO4 2c
3	5-6	Excellent analysis of the impact the practices of a 'throw away' society are having on the environment. A thorough discussion, which deconstructs information and demonstrates logical connections and reasoning throughout. Well-considered, relevant examples of how fashion designers could help alleviate impact on the environment.	3	Applies a thorough knowledge and understanding of designing and making principles to demonstrate, with well-considered, relevant examples how fashion designers could help alleviate impact on the environment.
		There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.		
2	3-4	Good analysis of the impact the practices of a 'throw away' society are having on the environment. A generally sound discussion, which deconstructs information and provides adequate connections and reasoning. Generally well-considered and relevant examples of how fashion designers could help alleviate impact on the environment	2	Applies a generally sound knowledge and understanding of designing and making principles to demonstrate, with generally well-considered and relevant examples how fashion designers could help alleviate impact on the environment
		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 impact the practices of a 'throw away' society are having on the environment. Little evidence of deconstructing information and limited connections are made. Few examples of how fashion designers could help alleviate impact on the environment.	1	Applies a basic knowledge and understanding of designing and making principles to partly demonstrate, with limited exemplification, how fashion designers could help alleviate impact on the environment
		There is limited evidence of relevant examples or structure.		
	0	No response or work that is worthy of a mark		

Question 9

Explain how the application of computer aided design (CAD) and computer aided manufacture (CAM) has impacted on the manufacturing industry for mass produced fashionable clothing.

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

Candidates should demonstrate knowledge and understanding of technical principles and designing and making principles and apply this to be awarded up to 9 marks based on:

Explanation of how CAD/CAM has impacted on the manufacturing industry could relate to any of the following points:

- Use of fashion specific software to develop ideas for new fashion collections.
- Developments of fashion illustrations could include colourways, pattern and print development for textile materials which can be instantly shared with clients for further discussion/approval.
- This speeds up the development process from design concept to manufactured product.
- Use of fashion specific software (CAD) to develop ideas for new embroidery designs to embellish textile materials which can be sent to multi head embroidery machines (CAM) and used in high volume fashion garment production which prior to CAD/CAM was not possible in large scale production .
- Intricate designs developed using specialist software (CAD) can be transferred to a laser cutter to be cut (or engraved) out of a textile material (CAM); this process/technique cannot be done in any other format as the laser cutter seals to edges of the material to prevent fraying; it opens up opportunities to fashion designers to create innovative designs; intricate patterns can be cut on clothing even on a large scale production run, not possible without a laser cutter.
- Templates for garment construction can be digitised for lay planning (CAD) for automated fabric cutting multiple layers, previously labour intensive and time consuming; developments on CAD/CAM is a more cost effective system particularly in high volume production .
- Designs/templates can be sent electronically to any factory worldwide regardless of what country the designs originated in; CAD/CAM has a direct impact on the globalisation of the fashion manufacturing industry.
- Utilising CAM as opposed to manual manufacturing of components/parts allows for large production output/quantities where QC is of a consistently high quality even in mass produced clothing.
- CAM allows repeatability, so produces identical fashion products/part products again and again even on a large production scale run.
- CAM systems also enable the manufacturer to respond more easily to changes in demand, easier to make modifications to products.

Candidates need to demonstrate knowledge and understanding of how CAD and the automated processes associated with CAM have impacted on the industry as opposed to manual processes or traditional methods of manufacture used previously or as an alternative.

Do not accept unqualified assertions such as easier, quicker or faster

Credit any other appropriate response.

Band	Marks	AO4 1b and 1c	Marks	AO4 2b and 2c
3	4-5	Demonstrates and applies a thorough knowledge and understanding of technical principles to the context of mass produced fashionable clothing on a global scale. Well-considered, relevant wider issues identified.	3-4	Demonstrates and applies a thorough knowledge and understanding of designing and making principles in the context of the fashion industry, 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 to the context of mass produced fashionable clothing on a global scale. Generally well-considered, relevant issues identified.	2	Demonstrates and applies a generally sound knowledge and understanding of designing and making principles in the context of the fashion industry. 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 to the context of mass produced fashionable clothing. Few issues are identified.	1	Demonstrates and applies a basic knowledge and understanding of designing and making principles in the context of the fashion industry. Few examples are provided.
		There is limited evidence of relevant examples or structure.		
	0	No response or work that is worthy of a mark		

Question 10

Product cycle graphs like the one shown below are often used by fashion buyers.

Evaluate the use of product cycle graphs by fashion buyers, on behalf of fashion retailers and manufacturers when planning and developing new products.

Q 10	Science	Maths	AO3		AO4				Total
			2a	2b	1a	1b	1c	2a	
				6			6		12

Candidates should provide evidence of appraisal and/or making judgements and applying this to be awarded up to 12 marks.

- An understanding of the product cycles and different types – What is a Fad, Fashion or basic (candidate could use different terms such as classic and standard); how long each type of fashion product stays popular for and why, helps with making judgements for new fashion products.
- Set stages within the cycles relate to speed/quantity of fashion products being sold and/or continuing to sell; this allows forward planning for repeat production to maintain sales or to organise a replacement product if sales are slowing down/or stopping.
- Fashion buyers can take into account when it is best to introduce a product, particularly a fad or a fashion product (though this can apply to basic products too) that is likely to be affected by seasonal factors. Launching a product at an appropriate time means that seasonal factors/demand can support an increase in sales evident in the introduction and growth stages of the product cycle.
- Fashion buyers will wish to ensure they are able to secure the product at an appropriate price and in appropriate volumes, depending on the stage of the product cycle. For example, they may seek to ensure that they are able to price the product low in the introduction stage, to help build market share, even if profitability is adversely affected at this point.
- Conversely, if a product is likely to have particular appeal for early adopters, it may be priced relatively highly from launch, with the option of reducing the selling price in late maturity and/or decline to promote sales at these stages.
- Fashion buyers will also seek to buy in appropriate volumes from the supplier – which could be less in the early part of the introduction stage than during growth or maturity, for example.
- In the growth stage, depending on the nature of the product, the fashion buyer may seek to incorporate additional features/options to help promote interest and demand for the product. They may also seek to purchase the product in greater quantities, possibly at lower cost from suppliers (economies of scale), in order to maximise profit while sales growth is strong.
- In the maturity stage, the fashion buyer may seek to incorporate additional features/enhancements, to help maintain demand/interest in the product and defend market share/give them a competitive advantage.
- In the decline stage, the fashion buyer may seek more significant changes to the product to help maintain interest/demand. Also, as initial development costs should have been covered in the earlier stages, there may be the opportunity to mitigate decline in sales by reducing the selling price.
- Depending on the profile of sales in the decline stage, a decision can be made about discontinuing the product (whilst recognising that the time taken to reach this stage will vary greatly across different products).

Credit any other appropriate response.

Band	Marks	AO3 2b	Marks	AO4 1c
3	5-6	Excellent evaluation of the use of product cycle graphs by fashion buyers, on behalf of fashion retailers and manufacturers when planning and developing new products. A thorough discussion, which appraises and/or makes judgements about the use of product cycle graphs. Well-considered, relevant wider issues used as a context for the discussion.	5-6	Applies a thorough knowledge and understanding of technical principles to the context of fashion buyers using product cycle graphs. 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 use of product cycle graphs by fashion buyers, on behalf of fashion retailers and manufacturers when planning and developing new products. A generally sound discussion, which appraises and/or makes judgements about the use of product cycle graphs. Generally well-considered, relevant issues used as a context for the discussion.	3-4	Applies a generally sound knowledge and understanding of technical principles in the context of fashion buyers using product cycle graphs. 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 use of product cycle graphs by fashion buyers, on behalf of fashion retailers and manufacturers when planning and developing new products. Little evidence of appraising or making judgements about the use of product cycle graphs. Few issues are identified.	1-2	Applies a basic knowledge and understanding of technical principles in the context of fashion buyers using product cycle graphs.
		There is limited evidence of relevant examples or structure.		
	0	No response or work that is worthy of a mark		



A LEVEL
DESIGN AND TECHNOLOGY
COMPONENT 1
Product Design
SAMPLE ASSESSMENT MATERIALS
Duration 3 Hours



ADDITIONAL MATERIALS

In addition to this examination paper you will need an answer book.

INSTRUCTIONS TO CANDIDATES

Answer **all** questions

Use black ink or black ball-point pen.

Do not use pencil or gel pen.

Do not use correction fluid.

INFORMATION FOR CANDIDATES

When and where appropriate, answers should be amplified and illustrated with sketches and/or diagrams.

The number of marks is given in brackets at the end of each question or part-question. You are advised to divide your time accordingly.

The number of marks available is 100.

You are reminded of the need for good English and orderly, clear presentation in your answers.

You may use a calculator in this examination.

1. (a) Name a SMART polymer material that can be used in the manufacture of a baby's bottle. [1]
- (b) Explain why the SMART material has been used in the design of the baby's bottle. [3]
- (c) State the name of the label that indicates the bottle has been approved by the British Standards Institute (BSI) and what is its purpose. [1]
- (d) Products that are certified by the British Standards Institute (BSI) have passed specific tests before being available to the consumer.

Describe a test that the baby's bottle would need to pass before being made available to the consumer. [3]

2. (a) A manufacturer plans to cut 41 discs from a sheet of mild steel 0.8m x 0.55m using a die cutter. Each disc is 86mm in diameter.

Calculate, to one decimal place, the percentage of waste material after cutting out all 41 discs. [6]

Show all calculations.

- (b) The manufacturer requires three holes to be drilled in specific locations on the discs. Explain how the use of a template would be beneficial. [2]
- (c) Describe one advantage of laser cutting the discs instead of die cutting them. [2]
- (d) The discs are to be used for a decorative mobile in a garden. Other than painting or varnishing, name two finishes that could be applied to the surface of the mild steel discs to prevent corrosion, identifying a specific, different feature of each surface finish. [4]

3. (a) The triple glazed window shown below has a frame made from extruded UPVC which has been cut to size from 10m lengths.

When producing the windows in an industrial unit, the manufacturer is required to carry out a five point risk assessment to ensure that the windows are cut, bonded and assembled correctly. If the first step of the risk assessment is to analyse the situation, describe the remaining four steps. [4]



- (b) The design of the die is essential to produce a high quality extruded profile.

Explain two design features of the die to ensure a high quality profile is achieved. [4]

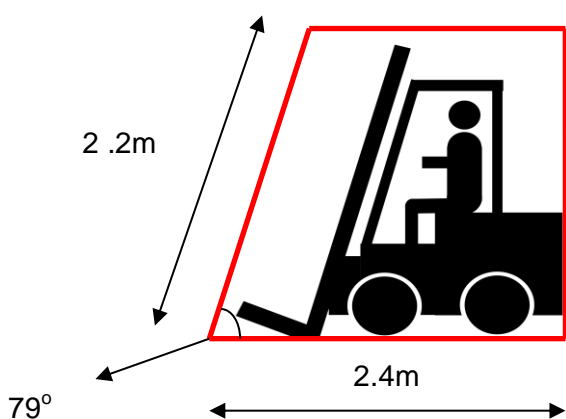
4. (a) A manufacturer uses the process of Just in Time (JIT) to produce washing machines.

Describe two benefits of JIT to the manufacturer. [4]

- (b) A manufacturer rents a storage space of 11,000 cubic metres at £4.32 per cubic metre a month from January to April. From May to December the manufacturer wishes to reduce the amount of storage space rented by 45%. As a consequence, the price per cubic metre will increase by 6%.

(i) Calculate the total cost of renting the space for one year. [4]
Show all calculations.

(ii) The red line below indicates the space that a fork truck would occupy within the factory. If the width of the fork lift is 1.2m calculate what would be the volume occupied by the fork lift truck. [5]
Show all calculations.



5. (a) Explain why products are subjected to incremental improvements over a period of time. [2]

(b) Explain how incremental improvements could impact on the design of a typical modern electric kettle. [4]

(c) Explain two factors that have contributed to improvements in the design and function of mobile phones over the past five years. [4]

6. Explain how the increasing use of composite materials has impacted on the design and manufacture of a specific item of sports equipment. [5]

7. (a) Analyse two ways in which a product designer can address issues of sustainability when designing and manufacturing wooden furniture. [6]

(b) Evaluate the benefits of trademarking to a designer. [6]

- 8.** Analyse the functional and environmental factors that would need to be considered when deciding on the material(s) to use in the design of a disposable drinks container. [9]
- 9.** Explain how the application of computer aided design (CAD) and computer aided manufacture (CAM) has impacted on car design and manufacture. [9]
- 10.** Evaluate how reverse engineering is used in the design and development of domestic products. [12]

COMPONENT 1

A level Design and Technology – Product design

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.

COMPONENT 1

Mark Scheme A level Design and Technology – Product Design

Question 1

- (a) Name a SMART material that can be used in the manufacture of a baby's bottle. [1]
- (b) Explain why the SMART has been used in the design of the baby's bottle. [3]
- (c) State the name of the label that indicates the bottle has been approved by the British Standards Institute (BSI) and what is its purpose. [1]
- (d) Products that are certified by the British Standards Institute (BSI) have passed specific tests before being available to the consumer.
- Describe a test that the baby's bottle would need to pass before being made available to the consumer. [3]

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

Candidates should demonstrate knowledge and be awarded 1 mark for:

- Thermochromic ink (accept thermochromic pigment).

Credit any other appropriate response.

1 (b)	✓					2	1		3
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Candidates should demonstrate understanding and be awarded up to 3 marks.

- The SMART material has been used in the design of the baby's to act as a safety feature [1] because the body of a normal bottle will act as an insulator and this may not initially inform the user that the liquid is hot [1].
- The change in colour will inform the user that the contents of the bottle have been heated. [1]
- If the baby's milk is too hot the ink or pigment will change to a deeper colour [1] and alert the parent to check the temperature.

Credit any other appropriate response.

1 (c)						1						1
<p>Candidates should demonstrate knowledge and be awarded 1 mark for:</p> <ul style="list-style-type: none"> • Kitemark label (accept labels that make reference to ISO numbers or CE symbol) it informs the customer that the product has passed all the required standard tests for safety. <p>Only credit a response if there is a supporting explanation of its purpose.</p>												
1 (d)						2	1					3
<p>Candidates should demonstrate understanding and be awarded up to 3 marks based on description of an appropriate test, such as:</p> <p>Drop/toughness test - the bottle would be dropped from specific heights both with and without liquid [1]. The bottle would be closely examined at each drop point for damage.[1] Used to check that the bottle is able to withstand normal daily use [1].</p> <p>Top Load Testing (Accept crush testing or compressive testing) The bottle is simply put between two flat faces of a compression machine and compressed, readings taken at specific intervals [1]. Used to check the compressive forces incurred during handling, transportation and storage (1).To ensure the product is able withstand being stacked [1].</p> <p>Closure Torque Test. The bottle is simply secured at the base in a rotating turntable and the top part of the bottle is held stationary. The turntable is then turned creating a torsional force. [1] This could be done on the bottle or the screw cap. Accept either answer. It is a measure of the turning force applied to lock the screwcap [1] or the ability of the bottle to withstand a turning force.</p> <p>Tests tamper resistance and the security of the screwcap [1] and are another test of the strength of the bottle.</p> <p>Credit any other appropriate response.</p>												

Question 2

- (a) A manufacturer plans to cut 41 discs from a sheet of mild steel 0.8m x 0.55 m using a die cutter. Each disc is 86mm in diameter.
Calculate the percentage of waste material remaining after cutting out all 41 discs. *Answer should be to one decimal place.* [6]
- (b) The manufacturer requires three holes to be drilled in specific locations on the discs. Explain how the use of a template would be beneficial. [2]
- (c) Describe one advantage of laser cutting the discs instead of die cutting them. [2]
- (d) The discs are to be used for a decorative mobile in a garden.
(i) Explain one problem that will arise when using the mild steel discs in an outdoor setting. [2]
(ii) Using a named non-ferrous metal, explain how the discs would be more suitable as a result of using this non-ferrous metal. [2]

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

Candidates should demonstrate understanding and be awarded up to 6 marks based on appropriate mathematical calculations, such as:

Conversion of metres to millimetres = 800mm and 550mm **1 mark**
Area of sheet = 800mm x 550mm = **440,000 mm²** **1 mark**

Radius of circle = $\frac{86}{2} = 43\text{mm}$
Area of one disc = πr^2
 $= \pi \times 43^2 \text{ mm}^2$
 $= 5808.8 \text{ mm}^2 \times 41 = \mathbf{238,160.8 \text{ mm}^2}$ **1 mark**
Remainder = 440,000 - 238,160.8
 $= \mathbf{201,839.2 \text{ mm}^2}$ **1 mark**
Percentage of waste = $\frac{201,839.2}{440,000} \times 100\%$ **1 mark**
 $= \mathbf{45.9\%}$ **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.

Accept any other mathematical method to achieve the final answer.

2 (b)							2		2
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Candidates should demonstrate understanding and be awarded up to 2 marks based on an explanation of the use of templates, such as:

- The holes could be marked out all at the same time [1] and the template would ensure that each hole on the disc is correctly positioned [1].
- This would be a faster way than measuring each hole centre individually [1] this method would also lead to possible inaccuracies in the marking out process [1].

Credit any other appropriate response.

2 (c)							2					2
<p>Candidates should demonstrate understanding and be awarded up to 2 marks based on: A description of one advantage of laser cutting the discs in comparison with die cutting them.</p> <ul style="list-style-type: none"> • An advantage of laser cutting the discs is that the laser beam will not wear during the laser cutting process [1] whereas the die cutters will lose their sharp edges over time [1]. • An advantage of laser cutting the discs is that no significant tooling costs are incurred with laser cutting, after equipment purchase, [1] whereas there is a need to produce a specified set of dies for die cutting [1]. • An advantage of laser cutting the discs is that there is reduced noise pollution in the working environment [1], in comparison with the physical stamping/pressing process with die cutting [1]. • An advantage of laser cutting the discs is that it is more straightforward to make modifications to batch runs by reprogramming the system [1], whereas there would be a need to produce a different set of dies for die cutting different designs [1]. <p>Credit any other appropriate response.</p>												
2 (d)	✓						4					4
<p>Candidates should demonstrate application of knowledge and understanding and be awarded up to 4 marks based on the selection of appropriate finishes and their features:</p> <p>Two applied finishes could be thermoplastic coating and galvanising.</p> <ul style="list-style-type: none"> • Thermoplastic coating [1]. • Feature – available in a broad range of colours to add aesthetic appeal to the discs [1]; or can be applied as a fairly thick coating to cover minor marks/blemishes on the surface of the steel disc [1] • Galvanising [1]. • Feature – the zinc coating on the disc may show a crystallised pattern [1]; or the surface of the disc would be offered some protection even if the zinc is scratched [1]. <p><i>Credit any other appropriate response. Note requirement for specific <u>different</u> features of each surface finish, however. Do not reward the same feature more than once, even if it is a relevant feature of both finishes identified.</i></p>												

Question 3

(a) When producing the windows in an industrial unit, the manufacturer is required to carry out a five point risk assessment to ensure that the windows are cut, bonded and assembled correctly. If the first step of the risk assessment is to analyse the situation, describe the remaining four steps. [4]

(b) The design of the die is essential to produce a high quality extruded profile.

Explain two design features of the die to ensure a high quality profile is achieved. [4]

Q 3	Science	Maths	AO3		AO4					Total
			2a	2b	1a	1b	1c	2a	2b	
3 (a)					4					4

Candidates demonstrate knowledge and are awarded up to 4 x 1 marks.

1 mark to be awarded for each appropriate step described.

Risk Assessment

Step 1 – Identify the hazards related to feeding polymer into extruder, removing lengths when extruded, storing / racking, marking cutting and fusing corners, fitting glazed panel.

Step 2 – who could be harmed and how. This would include all manual workers, deliveries, despatch and customers entering premises [1].

Step 3- Evaluate the risks / minimise the risk – reduce the risk by ensuring safe working practices are followed, increased awareness / signage, training, support for workers, etc. [1]

Step 4 – Record / document findings – as a result of the risk assessment, documentation should be completed appropriately and updated if existing. Records should be maintained for inspection / if issues arise [1].

Step 5 – Review regularly – follow an agreed schedule to review and update risk assessment as H&S policy [1].

Credit any other appropriate response.

3 (b)								4		4
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Candidates demonstrate knowledge and are awarded up to 4 marks.

1 mark for identifying each design feature and 1 mark for an explanation of the feature.

Design features of the die:

- The finish must be mirror like [1], to achieve a high quality finish on the plastic [1].
- The size of the entry shape is slightly larger than the final extruded shape [1] tapered to allow the plastic to flow through the die [1].
- The design of the die must be able to withstand extreme pressures exerted on it [1] and extreme high temperatures [1].
- The die must be made from a hard wearing material [1] if the manufacturer is to make a profit as he will expect to produce thousands of units [1].

Credit any other appropriate response.

Question 4

- (a) A manufacturer uses the process of Just in Time (JIT) to produce washing machines.
Describe two benefits of JIT to the manufacturer. [4]
- (b) A manufacturer rents a storage space of 11,000 cubic metres at £4.32 per cubic metre a month from January to April. From May to December the manufacturer wishes to reduce the amount of storage space rented by 45%. As a consequence, the price per cubic metre will increase by 6%.
- (i) Calculate the total cost of renting the space for one year. [4]
After reducing the storage facility, the manufacturer purchases stock. Each unit measures 0.45 cubic metres.
- (ii) The red line below indicates the space that a fork truck would occupy within the factory. If the width of the fork lift is 1.2m calculate what would be the volume occupied by the fork lift truck. [5]

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

Candidates should demonstrate knowledge and understanding and are awarded up to 2 marks per benefit (to a maximum of 4 marks) based on a description of the benefits of JIT to the manufacturer.

- Less storage space is needed when a JIT approach is adopted [1] because the components / materials are taken straight to the production line rather than being held in storage for some time before use [1].
- Less capital is tied up in stock when a JIT approach is adopted [1] which can have cash-flow benefits for the business [1].
- It can be more straightforward to implement changes to a design when a JIT approach is adopted [1] because the company is not faced with the issue of using up a significant amount of old stock [1].

Credit any other appropriate response.

4 (b) i	6					4			4
<p>Candidates should apply knowledge and understanding and are awarded up to 6 marks based on:</p> <p>Jan – Apr: $11,000 \times 4.32 \times 4 = \text{£}190,080$ 1 mark</p> <p>Reduced Space: $11,000 \times 0.45 = 4,950.$ $11,000 - 4,950 = 6,050$ cubic metres 1 mark</p> <p>Increase in price per cubic metre:</p> <p>May – Dec: $6,050 \times \frac{(4.32 \times 106)}{100} \times 8 = \text{£}221,633.28$ 1 mark</p> <p>Total cost for year: $190,080 + 221,633.28 = \text{£}41713.28$ 1 mark</p> <p>Do not penalise for any errors carried forward. Continue to award marks if you can clearly see the mathematical method used by the candidate.</p> <p><i>Credit any other appropriate response.</i></p>									
4 (b) ii	1					5			5
<p>Calculation vertical height</p> <p>$\sin 79^\circ = \frac{\text{opp}}{\text{Hyp}}$</p> <p>$\text{Opp} = \sin 79^\circ \times 2.2\text{m}$ 1 mark</p> <p>$= 2.16\text{m}$ 1 mark</p> <p>Calculation of Side Elevation</p> <p>$\tan 79 = \frac{\text{opp}}{\text{adj}}$</p> <p>$\text{Adj} = \frac{2.16}{\tan 79}$ $= 0.42$ 1 mark</p> <p>$\text{Area} = \frac{(0.42 \times 2.16) + (2.16 \times 1.98)}{2}$</p> <p>$\text{Area} = 0.4536 + 4.2768$ $= 4.7304\text{m}^2$ 1 mark</p> <p>$\text{Volume} = 4.7304 \times 1.2 = 5.6764\text{m}^3$ (accept 5.68m^3) 1 mark</p> <p>Do not penalise for any errors carried forward. Continue to award marks if you can clearly see the mathematical method used by the candidate.</p> <p><i>Credit any other appropriate response.</i></p>									

Question 5

- (a) Explain why products are subjected to incremental improvements over a period of time. [2]
- (b) Explain how incremental improvements could impact on the design of a typical modern electric kettle. [4]
- (c) Explain two factors that have contributed to improvements in the design and function of mobile phones over the past five years. [4]

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

Candidates should demonstrate knowledge and be awarded up to 2 marks for an explanation of why products are subjected to incremental improvements over time.

Incremental improvements based on:

- Aesthetics, form and styling of the product may change [1] – to reflect changes in taste / fashion [1], **or** to update a product at a lower cost than a complete redesign [1].
- Responses may also make reference to historical or technological developments [1] which influence the improvements/changes [1].

Credit any other appropriate response.

5 (b)						4			4
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Candidates should demonstrate understanding and are awarded up to 4 marks.

The candidate must show an understanding of incremental improvements based on explanation of how incremental improvements could impact on the design of a modern kettle :

- Inclusion of styling/streamlining/aesthetics in parts of the kettle [1] to meet fashion needs [1].
- The use of new components / additional features [1], in order to make the kettle more appealing to the target audience [1].
- Newer and more efficient materials and technology being developed [1] for example the use of thermochromic polymers that will change colour with heat.

Credit any other appropriate response.

5 (c)						4				4
<p>Candidates should demonstrate understanding and are awarded up to 4 marks based on an understanding of improvements. Up to two marks are awarded per factor, based on an explanation of how that factor has contributed to improvements.</p> <ul style="list-style-type: none">• Battery development - has become smaller [1] which has reduced the size of the phone without reducing its standby or usage time [1].• Sizes of components – ICs are becoming more compact [1] and their performance and processing capabilities have improved [1].• Material development – screens are brighter/have better resolution and use less energy [1] which improves the life of the phone between charging [1]. <p><i>Credit any other appropriate response.</i></p>										

Question 6

Explain how the increasing use of composite materials has impacted on the design and manufacture of a specific item of sports equipment. [5]

	Science	Maths	AO3		AO4			Total
			2a	2b	2a	2b		
Q6						5		5

Candidates should demonstrate understanding and are awarded up to 5 marks.

Explanations must make reference to sporting equipment (for example, golf shafts, tennis rackets, surfboards, hockey sticks, etc.)

Benefits of Composites

In comparison to traditional materials such as metal and wood, composites can provide a distinct advantage for the performer.

The primary advantages in the adoption of composites are their lightweight properties [1] and improved strength/weight ratio [1]. In sporting equipment, lightweight composites allow for longer drives in golf, faster swings in tennis, and straighter shots in archery [1]. Responses may also make reference to properties of composites including:

- Non-corrosive
- Non-conductive
- Flexible, will not dent
- Low maintenance
- Long life
- Design flexibility
- Aesthetic qualities.

Credit any other appropriate response.

Question 7

- (a) Analyse two ways in which a product designer can address issues of sustainability when designing and manufacturing wooden furniture. [6]
- (b) Evaluate the benefits of trademarking to a designer. [6]

Q 7	Science	Maths	AO3		AO4			Total	
			2a	2b	1b	1c	2a		2b
7 (a)	✓		4					2	6

Candidates should show evidence of *logical reasoning* or *deconstructing information* and *applying* this to be awarded up to 6 marks.

The question refers to two 'ways' a product designer can address issues of sustainability. The maximum mark per 'way' is three – two marks for analysis and one for application to the context of wooden furniture.

Typical ways in which a product designer can address issues of sustainability are:

- The designer would need to consider the sourcing of the materials for the wooden furniture [1] as using a local supplier will reduce on transportation, thus potentially reducing emission of gases to the atmosphere [1]. The designer could also seek to obtain the materials from sustainable managed forests to reduce the overall impact on the environment [1].
- The designer would need to consider the waste generated by the activity of manufacturing the wooden furniture [1]. This would include maximising the number of pieces from a length of wood, by carefully considering the layout/marketing of individual pieces [1] but should also consider waste more generally, for example, in relation to energy consumed during the manufacturing process [1].
- The designer would need to consider all materials used during the manufacture of wooden furniture, such as adhesives and finishes [1]. The designer could specify, as far as practicable, the use of natural adhesives and finishes so that the potential for release of harmful gasses is reduced [1] and waste material can be disposed of / recycled in a sustainable manner [1].
- The designer would need to consider the whole life-cycle of the wooden furniture so that eventual disposal (recycling) is as straightforward as possible [1]. Also, the designer could consider the use of recycled materials within the wooden furniture itself, both reducing the amount of new material(s) required and encouraging recycling by consumers [1]. The adoption of recognised systems for improving sustainability (for example the 6Rs) can have a positive impact across the entire life of the product [1].

Credit any other appropriate response.

Q7 (b)					4		2												6
<p>Candidates should show clear evidence of <u>appraisal</u> and/or <u>making judgements</u> and <u>applying</u> this to technical principles to be awarded up to 6 marks.</p> <p>Indicative content</p> <ul style="list-style-type: none"> • Trademarking benefits – legal protection for an inventive step or idea [1], it is meant to stop any other person or organisation copying the idea/invention [1]. • Refers to a recognizable sign design or expression [1]. Can be linked to the original designer [1], design company or manufacturing company [1]; • Registered trademarks offer full protection [1] - Apple and Amazon have both been pursuing legal action on the word 'APP'. • Can be located on a product, label package etc [1] . • Trademarks have to be applied/registered and have a limited life which can be extended- ten years initially [1]. • They have to be registered in the country of source [1] and apply separately for international trademark to stop the any possible copying of the idea or invention [1]; • Trademarks can also be purchased under a license agreement [1] i.e. Lego had to apply to Lucas films to launch their version of Lego Star Wars; • Trademarks and patents are often applied for together to stop an idea or invention be copied [1]. <p><i>Credit any other appropriate response.</i></p>																			

Question 8

Analyse the functional and environmental factors that would need to be considered when deciding on the material(s) to use in the design of a disposable drinks container. [9]

Q 8	Science	Maths	AO3		AO4				Total
			2a	2b	2a	2b	2c		
			6				3		9

Candidates should provide evidence of *logical reasoning* or *deconstructing information* and *applying* this to be awarded up to 9 marks. The focus should be on the analysis of the factors, though candidates are expected to apply knowledge and understanding of designing and making principles in the deconstruction of information and discussion.

Answers must be related to functional and environmental factors that should be considered in the specific context of material choice for a disposable drinks container.

Functional

The material used must:

- ensure that the final weight of the container is kept as lightweight as possible without reducing its strength;
- be able to retain its shape when holding hot or cold liquids and not absorb the liquids inside;
- be able to resist the heat of the liquid, have an outside texture that is comfortable to hold in the hand and the material should have insulating properties;
- have enough strength to be able hold the liquid when full, be able to be jointed/rolled/folded without leaking (depending on manufacturing process) and be hygienic.

Environmental

- Able to be recycled to protect our environment and reduce the waste sent to landfill sites;
- From managed resources, or even better, use recycled materials by using managed or recycled sources; a need to manage our natural depleting raw materials;
- Disposable drinks containers are often just sent to landfill sites which is an issue in itself, but also many containers will produce unwanted chemicals when they decompose and these will leech into the ground;
- Disposable cups could be manufactured from biodegradable materials. Biodegradable materials come from plant matter, which will not be harmful to the environment, presently the cost of natural biodegradable materials is high both in a raw state and to manufacture which should not put off manufacturers but it does.

Credit any other appropriate response.

Band	Marks	AO3 2a	Marks	AO4 2c
3	5-6	Excellent analysis of the functional and economic factors that need be considered when designing a disposable drinks container. A thorough discussion, which deconstructs information and demonstrates logical connections and reasoning throughout. Well-considered, relevant functional factors and environmental factors used as a context for the discussion	3	Applies a thorough knowledge and understanding of designing and making principles to the selection of materials for a disposable drinks container, with well-considered relevant functional factors and environmental factors identified.
		There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.		
2	3-4	Good analysis of the functional and economic factors that need be considered when designing a disposable drinks container. A generally 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 generally sound knowledge and understanding of designing and making principles to the selection of materials for a disposable drinks container, with generally well-considered factors identified.
		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 functional and economic factors that need be considered when designing of a disposable drinks container. 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 selection of materials for a disposable drinks container.
		There is limited evidence of relevant examples or structure.		
	0	No response or work that is worthy of a mark		

Question 9

Explain how the application of computer aided design (CAD) and computer aided manufacture (CAM) has impacted on car design and manufacture.

[9]

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

Candidates 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:

- Digitising templates for production. 3D scanning of a scale prototype of a body shell for up scaling and full size prototyping.
- Designs can be sent electronically to any factory worldwide as the majority of car manufacturing is undertaken in individual plants/factories responsible for individual component. i.e. Axles, bodywork, engine, electrics.
- Changes following client discussions can be implemented easily, customer's specific requirements are sent automatically to different parts of the world to different plants automatically.
- Using CAD to determine streamline efficiency of a prototype vehicle body shell in a virtual simulation prior to wind tunnel scale model testing.
- Use of CAD software to determine stress analysis on automotive component parts or assembly of a range of parts.
- Conceptual automotive designs visualised in CAD using conventional outputs and virtual environments (Virtual Reality).
- Allows a designer to quickly and effectively modify designs.
- Advantages of parametric modelling on component design reduces development cycle times.
- CAD can enable the car manufacturer to respond more easily to changes in demand, easier to make modifications to products.
- Utilising CAM as opposed to manual manufacturing of components/parts many of the parts used within the car industry rely on various machining techniques to produce various component parts such as windscreens, body shells, various internal parts, door panels etc.
- Quality tends to be high.- CAM machines are able to do repetitive processes accurately over and over which is essential in the manufacture of modern days cars. Many of the processes used within the car industry require repeatability, so produces identical products again and again.
- Traditionally cars were made in production lines by manual workers, CAM machines have reduced human error, bringing about increased standards.
- CAM machines don't require breaks- speed - can be steady but output is consistent. Car engines now require tight tolerances, CAM machines are able to work too such tolerances for example, components within the engine making the engine more efficient.
- The car industry works 24/7 with minimal downtime for maintenance/cleaning which increases the output of cars.
- Car designs are constantly changing, CAM systems enable the car manufacturer to respond more easily to changes in design making it easier to make modifications.

Candidates need to demonstrate knowledge and understanding of how CAD and the automated processes associated with CAM have impacted on the industry as opposed to manual processes or traditional methods of manufacture used previously or as an alternative. Do not accept unqualified assertions such as easier, quicker or faster.

Band	Marks	AO4 1b and 1c	Marks	AO4 2b and 2c
3	4-5	Demonstrates and applies a thorough knowledge and understanding of technical principles in the context of the car industry. Well-considered, relevant wider issues identified.	3-4	Demonstrates and applies a thorough knowledge and understanding of designing and making principles in the context of the car industry, 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 to the context of the car industry. Generally well-considered, relevant issues identified.	2	Demonstrates and applies a generally sound knowledge and understanding of designing and making principles in the context of the car industry. 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 to the context of the car industry. Few issues are identified.	1	Demonstrates and applies a basic knowledge and understanding of designing and making principles in the context of the car industry. Few examples are provided.
		There is limited evidence of relevant examples or structure.		
	0	No response or work that is worthy of a mark		

Question 10

Evaluate how reverse engineering is used in the design and development of domestic products. [12]

Q 10	Science	Maths	AO3		AO4			Total
			2a	2b	1a	1b	1c	
	✓			6			6	12

Candidates should provide evidence of either appraisal and/or making judgements and applying this to be awarded up to 12 marks based on:

Indicative content:

- This is the process of discovering the technological principles of a product, device or system. It enables the designer to analyse and evaluate all aspects of the internal and outside parts design of a domestic product. The candidate could mention obsolescence at this point, where other manufacturers will design products that will need to be broken or damaged to look at the internal workings. Often hand controls on products are sealed units.
- By analysing the product's internal structure and form it will enable a designer to analyse and consider how to assess any issues with its design that have appeared over time and to look at ways to overcome these problems. e.g hairdryers often show areas within the plastic body of overheating or where heat has occurred and melted the plastic body.
- By disassembling products from competitors the designer can analyse the technology used in the competitor products to discern if the product or technology can be duplicated or enhanced, this in itself can significantly reduce the product development cycle.
- Most products are normally designed on CAD machines where sizes and dimensions are available. Reverse engineering allows the designer to measure and record sizes that may not be available, in fact modern products are now taken apart and scanned to get exact sizes.
- Reverse engineering of existing products also allows the designer to look at the existing function, to assess if the whole design needs to be changed or just modifications/upgrades, which will save money for the manufacturer.
- Reverse engineering also allows for the designer to look in detail at how to improve the efficiency and effectiveness of the product. By disassembling the products that have been used for a number of years the designer is able to review and find issues such as fatigue cracks, parts that may show signs of age or working loose etc.
- Reverse engineering can also be used to fault find issues with design, this would enable the designer to look at improvements.

Credit any other appropriate response.

Band	Marks	AO3 2b	Marks	AO4 1c
3	5-6	Excellent evaluation of reverse engineering used in the development of products. A thorough discussion, which appraises and/or makes judgements about the use of reverse engineering in the development of domestic products. Well-considered, relevant wider issues used as a context for the discussion.	5-6	Applies a thorough knowledge and understanding of technical principles to the use of reverse engineering in the development of domestic products. 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 reverse engineering used in the development of products. A generally sound discussion, which appraises and/or makes judgements about the use of reverse engineering in the development of domestic products. Generally well-considered, relevant issues used as a context for the discussion.	3-4	Applies a generally sound knowledge and understanding of technical principles to the use of reverse engineering in the development of domestic products. 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 reverse engineering used in the development of products. Little evidence of appraising or making judgements about the use of reverse engineering in the development of domestic products. Few issues are identified.	1-2	Applies a basic knowledge and understanding of technical principles to the use of reverse engineering in the development of domestic products.
		There is limited evidence of relevant examples or structure.		
	0	No response or work that is worthy of a mark		