OCR
Oxford Cambridge and RSA

Accredited

GCSE (9–1) Design and Technology

J310/01 Principles of Design and Technology

Sample Question Paper Version 3.1

Date – Morning/Afternoon

Time allowed: 2 hours

You must have:
- the Insert

You may use:
- a scientific calculator
- a ruler
- geometrical instruments

First name										
Last name										
Centre number						**Candidate number**				

INSTRUCTIONS
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- The Insert will be found inside this document, it must be used when answering questions in **Section B**.
- Where appropriate, your answers should be supported with working. Marks may be given for a correct method even if the answer is incorrect.
- Write your answer to each question in the space provided. Additional paper may be used if necessary, but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION
- The total mark for this paper is **100**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended responses will be assessed in questions marked with an asterisk (*).
- This document consists of **20** pages.

SECTION A

Answer **all** the questions.

1 **Fig.1** shows a child's high chair.

Fig.1

(a) Features of the child's high chair are listed below.

Join each feature to the correct description. One has been done for you.

Feature	Description
Padded seat	A part of the chair that provides extra comfort
Reinforced corners	A part of the chair that is made from sustainable material
Seat back	A part of the chair that has a function that helps its storage
Fairtrade cotton straps	A part of the chair that adds extra strength
Folding legs	A part of the chair that is ergonomically designed

[3]

(b) Explain how current trends could influence a redesign of the child's high chair.

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……**[2]**

(c) The food tray of the child's high chair is made from a thermo polymer material.

(i) Name a suitable specific thermo polymer that could be used for the food tray.

…….. **[1]**

(ii) Give **two** properties of thermo polymer materials that make them suitable for the food tray.

1 ……..……..

2 ……... **[2]**

(d) The legs of the high chair are made from mild steel tubing.

(i) Explain how **one** property of mild steel enables the high chair to function effectively.

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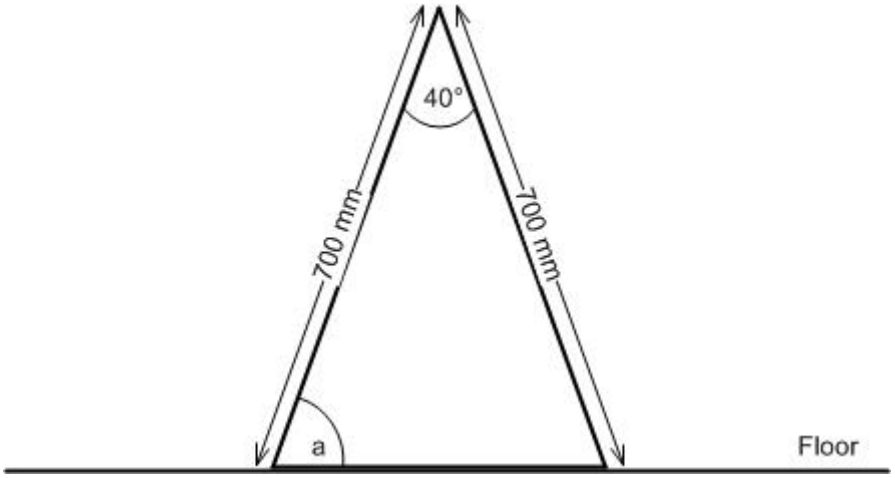
……..……

…….... **[2]**

(ii) **Fig. 2** shows an isosceles triangle that is formed from the floor when the chair legs are fully opened.



Not to scale

Fig. 2

Calculate angle **a**.

Angle **a** =…… **[2]**

(e) Anthropometric data is used when designing products.

(i) Give **two** pieces of anthropometric data that the designer of the child's high chair would need to know.

1……..……..

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2 ……..……..

…… **[2]**

(ii)* Evaluate the importance of using anthropometric data when designing. To support your answer, refer to products, other than the high chair, that you are familiar with.

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……**[8]**

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Turn over for the next question

2 A manufacturer of fashion accessories is developing a range of handbags.

Fig. 3 shows the design of a handbag.

Fig. 4 shows the front panel of the handbag design.

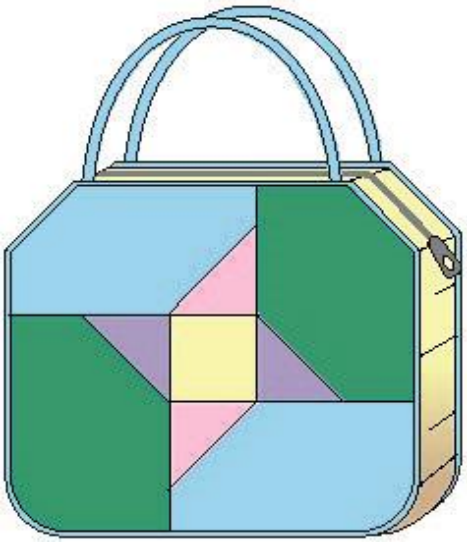


Fig. 3

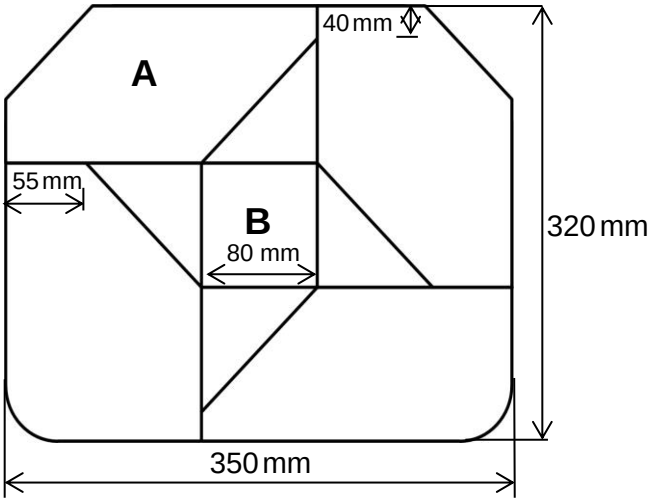
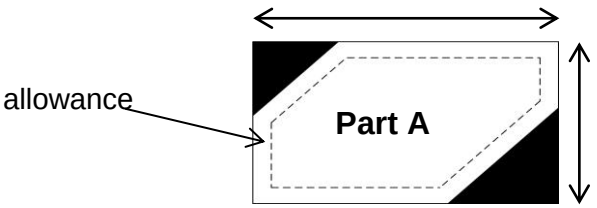


Fig. 4

(a) In **Fig. 4** Part **B** is a square and all four triangular parts are isosceles triangles.

Part **A** in **Fig. 4** is cut from a rectangular piece of fabric as shown in **Fig. 5** below.



Not to scale
Fig. 5

(i) Calculate the dimensions of the rectangular piece of fabric needed for Part **A**. There is an allowance of 15 mm.

Dimensions = ……mm × ……mm **[3]**

(ii) When Part **A** is cut from the rectangular piece of fabric, there is fabric left over as waste.

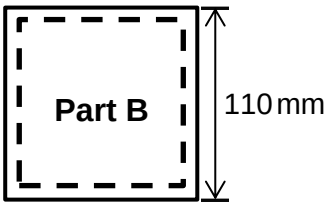
Calculate the fraction of fabric that would be wasted given that Part **A** has an area of 29 400 mm^2 including the allowance.

Show your answer to the lowest fraction.

Fraction of wasted fabric =..... **[3]**

(b) The manufacturer needs to work out the cost of each piece of fabric for the handbag.

Part **B** in **Fig. 6** is square.



Not to scale
Fig. 6

12 pieces of Part **B** can be cut from a width of fabric.

Calculate the length of fabric required to cut 180 pieces of Part **B**.

Length of fabric required = ...mm **[2]**

(c) The total cost of making one handbag is £28.35. The manufacturer will sell the handbags to retailers at £43.50 each.

Calculate the percentage profit made.

Profit = ……% **[2]**

(d) The designer of the handbag has chosen to re-use materials from old products to make the bag.

Identify **two** considerations when re-using materials and/or system components to make a new product.

1 ……

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2 ……

……**[2]**

(e) Explain **two** benefits to a manufacturer of designing and making products in a way that reduces environmental impact.

1 ……

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2 ……

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……**[4]**

3 **Fig. 7** shows a robotic lawnmower.

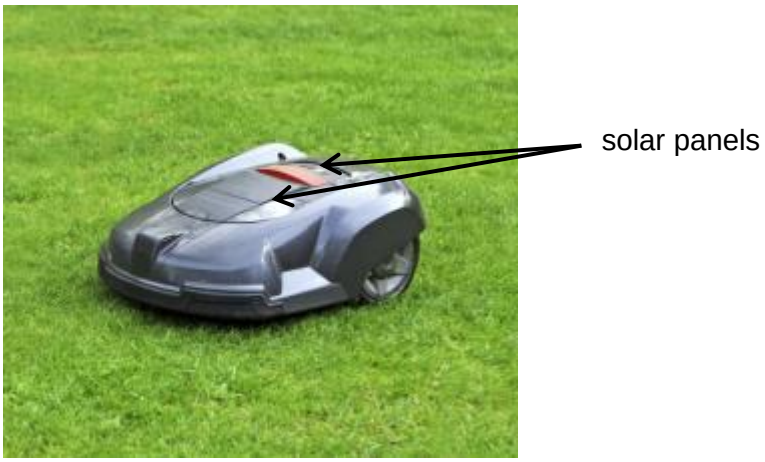

Fig. 7

(a) The lawnmower has a number of inputs and outputs in its circuit that sense obstacles in its path and allow it to move around them.

The table below shows some of the functions of the robotic lawnmower.

Complete the table with the missing inputs or outputs and electronic components.

Function	**Input or Output**	**Electronic component**
Sensing obstacles	……..	Push to make switch / Infra-red
Moving wheels	Output	Motor
Making a sound when it hits an obstacle	Output	……
Warning light to show when the power level is low	……..	……..
Triggers to mower to switch off if it topples over	Input	Tilt switch

[4]

(b) The robotic lawnmower receives its energy from solar panels.

Explain **one** advantage and **one** disadvantage of using solar panels for receiving energy. Use products you are familiar with to support your answer.

Advantage ...……

……...……

……...……

Disadvantage ...……..……

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[4]

(c) **Fig. 8** shows a pie chart of the quantity of electricity generated by different types of fuel in the UK in 2015.

Total electrical energy is measured in Terrawatt-hours (TWh)

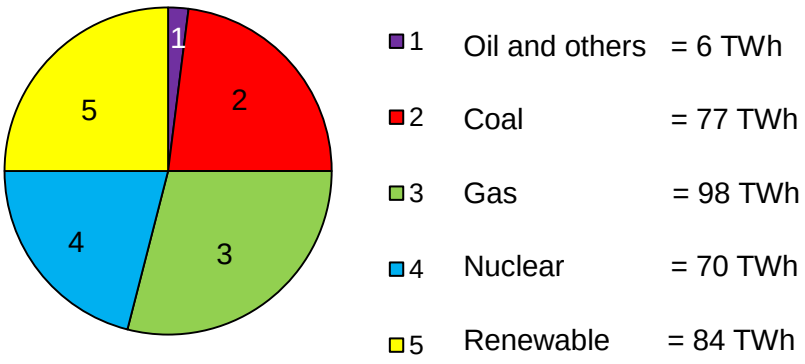

Fig. 8

(i) Calculate the fraction of total electrical energy that is generated by renewable fuels. Give your answer as a fraction in its lowest form.

Fraction of renewable fuels = ……..**[1]**

(ii) Hydro-electricity is one type of renewable energy shown in **Fig. 8**.

The ratio, hydro-electricity to other renewable energy is 1 : 12.

Calculate the energy generated by hydro-electricity to the nearest decimal.

Energy generated = ……**TWh [2]**

(d) New and emerging technologies influence the design of many products.

Discuss how new and emerging technologies have been used to improve the function and/or performance of products.

Use examples to support your answer.

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……**[6]**

SECTION B

Answer **all** the questions.

For **all** questions in Section B you **must** refer to the **Insert** which contains images and information about products that you would find in a train station.

4 Refer to page 8 of the Insert.

(a) The information leaflets shown in **Image A** are made from paper.

Give **two** reasons why paper is suitable for this product.

1 ……..…….

……...

2 ……..…….

……..**[2]**

(b) The leaflet display in **Image A** uses the polymer acrylic to hold the leaflets in place.

Give **one** benefit of acrylic being used.

…….

……..**[1]**

(c) The person in **Image B** is wearing a red coat made from a natural fibre.

(i) Name **one** natural fibre.

..……..**[1]**

(ii) Explain **one** property of natural fibres that make them suitable for the coat shown.

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……**[2]**

(d) **Image C** on the insert shows a locking device on a luggage trolley. **Fig. 9** below shows how to use the device. The £1 coin is inserted into the device. The key is released and pops out.

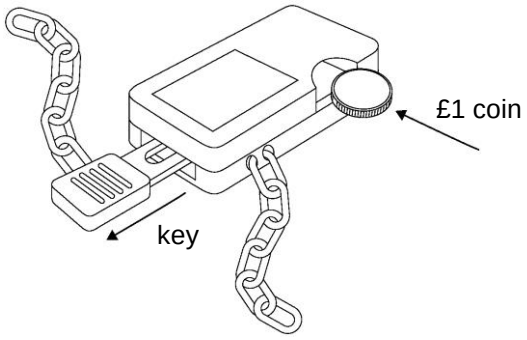

Fig. 9

(i) State the type of force that is required to insert a £1 coin into the locking device.

……..…**[1]**

(ii) State the type of motion that takes place when the key is released from the locking device.

……..…**[1]**

(e) The bench shown in **Image D** has a metal frame and wooden seat and back.

Explain why a hardwood has been used to make the seat and back of the bench rather than a softwood.

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……**[2]**

You need to answer questions **5** and **6** in relation to **one** of the products listed below covering an area you have studied in depth.

Information about the products is contained in the **Insert**.

Before you choose a product, read all parts of questions 5 and 6.

You **must** tick **one** box below to indicate your chosen product.

- ☐ **Product 1:** Coffee cup - (papers and boards)
- ☐ **Product 2:** High visibility jacket - (fibres and fabrics)
- ☐ **Product 3:** Customer satisfaction panel - (design engineering)
- ☐ **Product 4:** Retractable tape barrier - (polymers)
- ☐ **Product 5:** Toilet sign - (metals)
- ☐ **Product 6:** Flower planter - (timbers)

You should spend approximately 20 minutes on Question 5 (a).

5 Designers make prototypes to show their designs to key stakeholders.

(a) Study and use the images and technical information about your chosen product given on the Insert.

Produce a step-by-step plan to explain the stages that you would take if you were making a **final prototype** of your chosen product in a school workshop.

You **must** include details of:

- specific materials and components you would use to make the prototype
- the processes, techniques or skills you would use
- tools you would use, including digital technology as appropriate
- how you would ensure accuracy when making the prototype
- how you would finish it to present it to stakeholders. **[12]**

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(b) Designers use different approaches when designing to ensure stakeholders opinions are considered.

(i) Explain **one** approach that might be used to ensure the main stakeholders are given full consideration when designing.

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……**[2]**

(ii) Explain the importance of prototypes in discussions between designers and stakeholders.

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……**[3]**

(c) ‘Inclusivity is an important consideration in the design of products.’

Discuss the above statement in relation to products and/or systems located in a train station environment; use the images in the Insert to help you.

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……..**[6]**

6 You should use the same product you chose for Question 5 to answer this question.

(a) Materials need to be sourced and processed in order to be used to make products.

For **one** specific material from your chosen product:

- state the source of the material and
- describe how it is processed into a workable form.

Specific material ……

Source of material ……**[1]**

Description …… ……

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……**[3]**

(b)* Discuss how the selection of materials or components is influenced by social and ethical issues.

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END OF QUESTION PAPER

Summary of updates

Date	Version	Details
April 2022	3.1	Updated copyright acknowledgements.

OCR
Oxford Cambridge and RSA

…day June 20XX – Morning/Afternoon

GCSE (9–1) Design and Technology

J310/01 Principles of Design and Technology

SAMPLE MARK SCHEME

Duration: 2 hours

MAXIMUM MARK 100

This document consists of 32 pages

PREPARATION FOR MARKING

SCORIS

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *scoris assessor Online Training*; *OCR Essential Guide to Marking*.

2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are posted on the RM Cambridge Assessment Support Portal http://www.rm.com/support/ca

3. Log-in to scoris and mark the **required number** of practice responses ("scripts") and the **required number** of standardisation responses.

   YOU MUST MARK 10 PRACTICE AND 10 STANDARDISATION RESPONSES BEFORE YOU CAN BE APPROVED TO MARK LIVE SCRIPTS.

MARKING

1. Mark strictly to the mark scheme.

2. Marks awarded must relate directly to the marking criteria.

3. The schedule of dates is very important. It is essential that you meet the scoris 50% and 100% (traditional 50% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.

4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone, email or via the scoris messaging system.

5. Work crossed out:
   a. where a candidate crosses out an answer and provides an alternative response, the crossed out response is not marked and gains no marks
   b. if a candidate crosses out an answer to a whole question and makes no second attempt, and if the inclusion of the answer does not cause a rubric infringement, the assessor should attempt to mark the crossed out answer and award marks appropriately.

Multiple Choice Question responses:
When a multiple choice question has only a single, correct response and a candidate provides two responses (even if one of these responses is correct), then no mark should be awarded (as it is not possible to determine which was the first response selected by the candidate).

Contradictory responses:
When a candidate provides contradictory responses, then no mark should be awarded, even if one of the answers is correct.

Short Answer Questions (requiring only a list by way of a response, usually worth only **one mark per response**):
Where candidates are required to provide a set number of short answer responses then only the set number of responses should be marked. The response space should be marked from left to right on each line and then line by line until the required number of responses have been considered. The remaining responses should not then be marked. Examiners will have to apply judgement as to whether a 'second response' on a line is a development of the 'first response', rather than a separate, discrete response. (The underlying assumption is that the candidate is attempting to hedge their bets and therefore getting undue benefit rather than engaging with the question and giving the most relevant/correct responses.)

Short Answer Questions (requiring only a list by way of a response, worth **two or more marks**):
If the candidates are required to provide a description of, say, three items or factors and four items or factors are provided, then mark on a similar basis – that is downwards (as it is unlikely in this situation that a candidate will provide more than one response in each section of the response space.)

Longer Answer Questions (requiring a developed response):
Where candidates have provided two (or more) responses to a medium or high tariff question which only required a single (developed) response and not crossed out the first response, then only the first response should be marked. Examiners will need to apply professional judgement as to whether the second (or a subsequent) response is a 'new start' or simply a poorly expressed continuation of the first response.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there then add a tick to confirm that the work has been seen.

7. There is a NR (No Response) option. Award NR (No Response)
   - if there is nothing written at all in the answer space
   - OR if there is a comment which does not in any way relate to the question (e.g. 'can't do', 'don't know')
   - OR if there is a mark (e.g. a dash, a question mark) which isn't an attempt at the question.

   Note: Award 0 marks – for an attempt that earns no credit (including copying out the question).

8. The scoris **comments box** is used by your Team Leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**
   If you have any questions or comments for your Team Leader, use the phone, the scoris messaging system, or email.

9. Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

10. **Annotations**

Annotation	Meaning
BP	Blank page
✔	Point where mark is awarded
✘	Incorrect response
L1	Level one response
L2	Level two response
L3	Level three response
ECF	Error carried forward
REP	Repetition
SEEN	Noted, but no credit given
PD	Poor diagram offering unclear response

11. **Subject-specific Marking Instructions**

INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

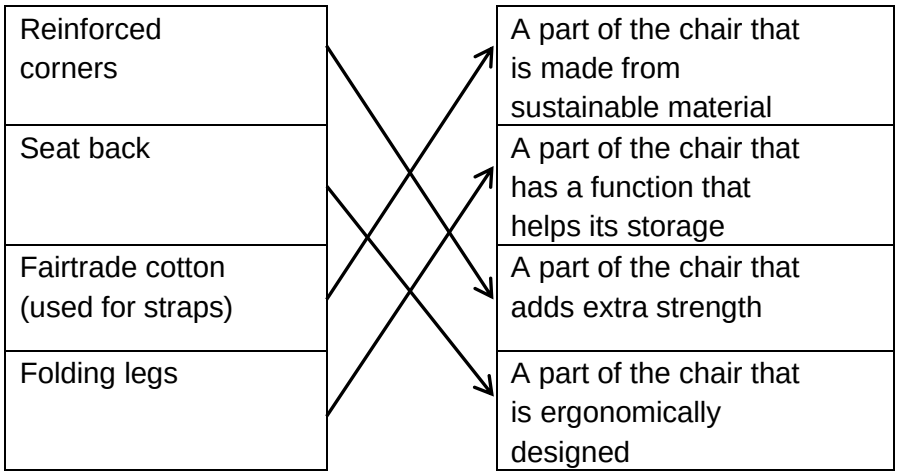
LEVELS OF RESPONSE QUESTIONS:
The indicative content indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance.

Using 'best-fit', decide first which set of level descriptors best describes the overall quality of the answer. Once the level is located, adjust the mark concentrating on features of the answer which make it stronger or weaker following the guidelines for refinement.
Highest mark: If clear evidence of all the qualities in the level descriptors is shown, the HIGHEST mark should be awarded.
Lowest mark: If the answer shows the candidate to be borderline (i.e. they have achieved all the qualities of the levels below and show limited evidence of meeting the criteria of the level in question) the LOWEST mark should be awarded.
Middle mark: This mark should be used for candidates who are secure in the level. They are not 'borderline' but they have only achieved some of the qualities in the level descriptors.

Be prepared to use the full range of marks. Do not reserve (e.g.) highest level marks 'in case' something turns up of a quality you have not yet seen. If an answer gives clear evidence of the qualities described in the level descriptors, reward appropriately.

The breakdown of Assessment Objectives for GCSE (9–1) Design & Technology

	Assessment Objective
AO3	**Analyse and evaluate –** • **design decisions and outcomes, including for prototypes made by themselves and others** • **wider issues in design and technology**
AO3.1a	Analyse design decisions and outcomes, including for prototypes made by themselves and others
AO3.1b	Evaluate design decisions and outcomes, including for prototypes made by themselves and others
AO3.2a	Analyse wider issues in design and technology
AO3.2b	Evaluate wider issues in design and technology
AO4	**Demonstrate and apply knowledge and understanding of –** • **technical principles** • **design and making principles**
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 design and making principles
AO4.2b	Demonstrate understanding of design and making principles
AO4.2c	Apply knowledge and understanding of design and making principles

Question			Answer	Marks	Guidance
1	(a)		**Feature** / **Description**  	**3** **AO4 2a**	**One** mark for each correct answer to a maximum of 3 marks. If a candidate supplied two alternative answers e.g. by drawing two lines to the same description from different features (even if one of these responses is correct), then **no** marks should be awarded.
1	(b)		Up to **two** marks for an explanation e.g.: The most current cartoon characters like minions often become trends (✓) this could influence the decoration of the child's chair, either by shape or pattern. (✓) <u>Other trends could relate to:</u> • to purchase environmentally friendly products • to seek multi-purpose products with new and interesting features • to buy products that use new finishes or materials. <u>Explanations could be in the form of:</u> • only using materials that come from environmentally sustainable sources • adding features that engage the child in cognitive activity. • new stain/moisture repellent finishes could add a marketing feature **Award credit for any other appropriate response**	**2** **AO4 2c**	1 mark for identifying a current trend that could offer influence. 1 mark for explaining how the trend could influence a redesign of the chair. Answers must be **appropriate** for the context in the question: Child's high chair.

Question			Answer	Marks	Guidance
1	(c)	(i)	**One** from: • HDPE • PVC • ABS • LDPE • PP **Award credit for any other appropriate response**	**1** **AO4 1c**	Answers must be **suitable** for the context in the question: Food tray for child's high chair. Do **not** accept PET, PS or Acrylic as these are not suitable for the food tray.
1	(c)	(ii)	**Two** from: • waterproof / wipe clean • available in bright colours • tough/hardwearing • lightweight • flexible • can be sterilised • easily moulded. **Award credit for any other appropriate response**	**2** **AO4 1c**	Answers must be **appropriate** for the context in the question: Food tray for child's high chair.
1	(d)	(i)	Up to **two** marks e.g.: • good strength to weight ratio (✓) therefore easy to carry around (✓) • strong (✓) enough to hold a child's weight (✓) • durable (✓) making it long lasting/hard wearing (✓) • lightweight (✓) making it easy to carry. (✓) **Award credit for any other appropriate response**	**2** **AO4 1c**	1 mark for identifying a property of mild steel that enables the high chair to function effectively. 1 mark for the reason why this feature supports the functional performance of the high chair. Answers must be **appropriate** for the context in the question: functional performance of the child's high chair.

Question			Answer	Marks	Guidance
1	(d)	(ii)	180 – 40 = 140 (✓) 140 ÷ 2 = 70 (✓) Or Angle **a** = 70°(✓)(✓) **Award credit for any other appropriate method of calculation**	**2** **AO4 1c**	1 mark for knowing that all angles add up to 180 and for subtracting 40 from 180 1 mark for knowing that the two remaining angles are the same and dividing by 2 **Correct answer scores full marks**
1	(e)	(i)	**Two** from: • average height of a child • average width of a child's hip/buttocks • length of a child's legs • height of the parent • length of child's arm • height of a child's back • buttock to knee length of child. **Award credit for any other appropriate response**	**2** **AO4 1c**	Answers **must** relate to human measurements. Do **not** award for the surrounding environment or the chair itself. Answers must be **appropriate** for the context in the question: Child's high chair.

Question			Answer	Marks	Guidance	
					Content	Levels of response
1	(e)	(ii)*	Answers could include: • provides information about sizes of human measurements that support the development of design solutions/products • covers a range of human sizes allowing the designer to target a range of users or specific users as appropriate (5^{th}/50^{th}/95^{th} percentile) • helps to improve user comfort and ease of use • helps to ensure design solutions/products fulfil user needs so they will be saleable. If anthropometric data is not considered the products may not: • be suitable for the users they are being designed for which may mean the product does not sell or people return the products because they don't fit. Examples used could relate to: • interface between humans and the products/systems they interact with • products that need to be carried by particular parts of the body • garments that cover the body (allowing for movement). **Award credit for any other appropriate response**	**8** **AO3** **4 x 1b** **AO4** **1 x 1a** **1 x 1b** **1 x 2a** **1 x 2b**	Examples of other products can be from any material area and may use examples of both good and bad use / consideration of anthropometrics. The question asks for other products; therefore do not accept a child's highchair as an example to support the candidate's discussion. A candidate operating at Level 3 should be accessing all AO4 marks and at least two of the AO3 marks. They will also be drawing on their wider knowledge of the whole subject. A candidate operating at Level 2 could be accessing marks in a variety of ways. All AO4 marks with limited evaluation (AO3), or a detailed evaluation around one example or only evaluate the positives or negatives. They should be drawing on some of their wider knowledge/experience of the whole subject.	**Level 3 (6–8 marks)** The candidate will demonstrate sound knowledge and understanding of anthropometrics and using data to link the product to the user when designing. They will be able to undertake a thorough evaluation of the importance of using anthropometrics identifying positive and negative implications. Candidates will be drawing on their wider understanding/experience of the whole subject through their exemplification and evaluation. A variety of relevant examples are used to effectively support the discussion. There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated with the use of examples. **Level 2 (3–5 marks)** The candidate will demonstrate sound knowledge and understanding of anthropometrics and using data to link the product to the user when designing. There will be a basic attempt to evaluate the importance of using anthropometrics. Evaluations will be one sided, identifying positive or negative implications or limited to evaluating one factor. Candidates could be drawing on some of their

Question			Answer	Marks	Guidance	
					Content	Levels of response
					A candidate operating at Level 1 will be accessing AO4 marks, but no AO3 marks.	wider understanding/experience of the whole subject through their exemplification and evaluation. Some relevant examples are used to support the discussion. There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence. **Maximum of 4 marks if no evaluation evident**. **Level 1 (1–2 marks)** The candidate will show limited knowledge of what anthropometric data is. There will be basic or no reference to understanding of how anthropometric data is important when designing. There is no attempt at evaluation. If examples are used to support the discussion they may not be relevant. The information has some relevance and is presented with limited structure or detail. The information is supported by limited evidence. **Level 0 (0 marks)** No response or no response worthy of credit.

Question			Answer	Marks	Guidance
2	(a)	(i)	80 + 40 and (2 × 80) + 55 (✓) (2 × 15) for each set of dimensions (✓) 80 + 40 + (2 × 15) = **150** and (2 × 80) + 55 + (2 × 15) = **245** (✓) Or Dimensions = 150mm x 245mm (**✓)(✓)(✓)** **Award credit for any other appropriate method of calculation**	**3** **AO4** **3 x 1c**	1 mark for accurately identify the missing dimensions from the information given. 1 mark for recognising the addition of allowance. 1 mark for correct calculations. **Correct answer scores full marks**
2	(a)	(ii)	$\frac{Total\ area\ -Part\ A\ area}{Total\ area}$ 150* x 245* = 36 750 mm^2 (✓) 36 750 mm^2 – 29 400 mm^2 = 7 350 mm^2 (✓) $\frac{7\ 350\,\text{mm2}}{36750\,\text{mm2}} = \frac{1}{5}$ (✓) Or Fraction of wasted fabric = $\frac{1}{5}$ (✓)(✓)(✓) **Award credit for any other appropriate method of calculation**	**3** **AO4** **2 x 1c** **1 x 2c**	1 mark for calculating the total area of the rectangle 1 mark for calculating the wasted area of fabric. 1 mark for calculating to the lowest fraction ***Error carried forward from 2 (a)(i)** **Correct answer scores full marks**

Question			Answer	Marks	Guidance
2	(b)		180 ÷ 12 = 15 (✓) 15 × 110 = 1650 mm (✓) Or Length of fabric required = 1650 mm (✓)(✓) **Award credit for any other appropriate method of calculation**	**2** **AO4 1c**	1 mark for dividing the number of pieces of Part B required (180) by the number of pieces of Part B that fit into a width of fabric (12). 1 mark for multiplying the size of the Piece B (110) by the number of repeats required (15). **Correct answer scores full marks**
2	(c)		£43.50 - £28.35 = £15.15 (✓) 15.15 ÷ 28.35 = 0.534, 0.534 x 100 = **53%** (✓) Or Profit = 53% (✓)(✓) **Award credit for any other appropriate method of calculation**	**2** **AO4 1c**	1 mark for calculating the raw profit in £ 1 mark for calculating this into Percentage Profit = (profit/cost price) x 100 in % **Correct answer scores full marks**
2	(d)		**Two** from e.g.: • materials will need to be free from damage • materials will need to be thoroughly cleaned • materials are not irreversible soiled/stained • materials are of an acceptable quality • components will need to be cleaned up before re-applying them • components on a board may need to be replaced due to defects • components will have to be tested to see if they are still effective • designer will have to find a reliable source where the materials are readily available. **Award credit for any other appropriate response**	**2** **AO4 1a**	1 mark for each valid point made.

Question			Answer	Marks	Guidance
2	(e)		Up to **two** marks for each benefit explained e.g.: • delivering products that reduce environmental impact is good for PR / publicity (✓), as it promotes a good image (✓) for the manufacturer • it helps to conserve resources (✓), so that the manufacturer can show that their output reduces (✓) environmental impact. Other benefits to the manufacturer could include: • meeting customers' environmental standards • design for easier / cleaner disposal of materials at the end of life • less harmful waste. Explanations could be in the form of: • results in higher sales • reduced carbon footprint / CO_2 • receive tax incentives / grants. **Award credit for any other appropriate response**	**4** **AO4** **2 x 1b** **2 x 2b**	1 mark for each benefit. 1 mark for a justified explanation of each benefit.

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>3</td><td>(a)</td><td></td><td>
<table>
<tr><th>Function</th><th>Input or Output</th><th>Electronic component</th></tr>
<tr><td>Sensing obstacles</td><td>Input (✓)</td><td>Push to make switch /
Infra-red</td></tr>
<tr><td>Moving wheels</td><td>Output</td><td>Motor</td></tr>
<tr><td>Making a sound when it hits an obstacle</td><td>Output</td><td>Piezo/Buzzer/Speaker /Bell/Siren (✓)</td></tr>
<tr><td>Warning light to show that the batteries are low</td><td>Output (✓)</td><td>Light emitting diode/LED/Liquid crystal display/LCD (✓)</td></tr>
<tr><td>Triggers to mower to switch off if it topples over</td><td>Input</td><td>Tilt switch</td></tr>
</table>
</td><td>4

AO4
3 x 1a

AO4
1 x 1b</td><td>One mark for each statement in the table:</td></tr>
</table>

Question			Answer	Marks	Guidance
3	(b)		Up to **two** marks for an advantage explained. **Advantage** e.g. Solar panels on the roof of your house for powering your domestic electricity are better for the environment than gas or oil (✓) as the source is indefinitely renewable from the sun and reduces the need to drill for fuels that are non-renewable (✓). <u>Other advantages could include:</u> • sustainable environmentally as it doesn't generate waste • solar energy is free. Up to **two** marks for a disadvantage explained. **Disadvantage** e.g. The levels of light available can be a problem when using calculators that are powered by solar (✓), if you need to use them in a room with low levels of light they are unlikely to function very well as these solar panels are very small and will struggle to take in enough light. (✓) <u>Other disadvantages could include:</u> • installation and maintenance from experts is costly • not enough energy to power products indefinitely, still need mains **Award credit for any other appropriate response**	**4** **AO3** **2 x 2a** **AO4** **2 x 1c**	1 mark for an appropriate advantage linked to the product given. 1 mark for the justified explanation. 1 mark for an appropriate disadvantage linked to the product given. 1 mark for the justified explanation. Justifications must relate directly to the advantage or disadvantage given. Candidates can use any suitable products to exemplify their answer. Answers must be **appropriate** to the exemplified product(s).
3	(c)	(i)	6 + 77 + 98 + 70 + 84 = 335 84 ÷ 335 = 0.2507 = 25% = $\frac{25}{100} = \frac{1}{4}$ (✓)	**1** **AO3** **1a**	1 mark for analysing the data to identify the appropriate data to correctly calculate the answer.

Question			Answer	Marks	Guidance
3	(c)	(ii)	1 : 12 = 1 + 12 = 13 (✓) 84 TWh ÷ 13 = 6.46 = 6.5 TWh (✓) Or 6.5 TWh (✓)(✓) **Award credit for any other appropriate method of calculation**	**2** **AO4 1c**	1 mark for understanding the ratio formula 1 mark for calculating the answer from the overall renewable energy to the nearest decimal **Correct answer scores full marks**

Question			Answer	Marks	Guidance	
					Content	Levels of response
3	(d)		Discussion should include knowledge and understanding of the impact of new and emerging technologies when developing design solutions in relation to how they improve the function and performance of new products. Examples of emerging technologies could include: • Nano technologies – medicines • Stem cell technology – genetics • Fuel cell technology – electric vehicles • Artificial intelligence – robots • Quantum Tunnelling Composites (QTC) – Membrane switches, pressure sensors • Piezo electric materials – microphones, headphones • Smart coatings – self-cleaning glass • Smart grease – volume knobs, watch mechanisms • Photochromic materials – react-a-light glasses. **Award credit for any other appropriate response**	**6** **AO3** **1 x 1a** **1 x 1b** **AO4** **4 x 1c**	Candidates should be drawing on example to support their answer. If no examples are used they should not be rewarded with marks higher than a Level 1. A candidate operating at Level 3 should be accessing all AO4 marks and at least one of the AO3 marks, relating to new technologies influence on both function and performance of products. A candidate operating at Level 2 could be accessing marks in a variety of ways. All/most AO4 marks with limited analysis or evaluation (AO3), or a clear analysis and evaluation around an example that is more likely to focus on influences on either function or performance. A candidate operating at Level 1 will be accessing AO4 marks, but no AO3 marks.	**Level 3 (5–6 marks)** The candidate will demonstrate an excellent understanding of new and emerging technologies. They will be able to discuss this convincingly, using examples of products to analyse and/or evaluate the influence of new technologies on the function and performance of the products. **Level 2 (3–4 marks)** The candidate will demonstrate some understanding of new and emerging technologies. They will be able to discuss this, using examples of products to analyse or evaluate the influence of new technologies on the function and/or performance of the products. **Level 1 (1–2 marks)** The candidate will give a basic answer showing limited understanding of how developments in new and emerging technologies have been used to improve the function or performance of new products. Any examples given may not be appropriate. Any attempt at analysis or evaluation will not be worthy of credit. **Level 0 (0 marks)** No response or no response worthy of credit.

Question			Answer	Marks	Guidance
4	(a)		**Two** from e.g.: • it is easy to print on • it is lightweight • it is easy to carry • it is easy to recycle when thrown away. **Award credit for any other appropriate response**	**2** **AO4 1c**	Answers must be **appropriate** for the context in the question: Information leaflet in image A.
4	(b)		**One** from e.g.: • it is clear so it is easy to see the leaflets on display. • it is a rigid polymer so good for retaining the leaflets. • it is hygienic and easily cleaned. • It is less dangerous than glass if broken. **Award credit for any other appropriate response**	**1** **AO4 1c**	Answers must be **appropriate** for the context in the question: Leaflet display in image A.
4	(c)	(i)	**One** from e.g.: • wool • silk • cotton **Award credit for any other appropriate response**	**1** **AO4 1a**	**Do not accept:** • mixed-fibres such as cotton/polyester.

Question			Answer	Marks	Guidance
4	(c)	(ii)	Up to **two** marks e.g. Natural fibres have good thermal properties (✓), as the coat is worn outside this will offer warmth to the wearer. (✓) Natural fibres offer good tensile strength (✓), so the coat will last and wear well over time. (✓) Other properties of natural fibres might include: • good absorbency (for dying them) • soft to the touch (for comfortable wear). **Award credit for any other appropriate response**	**2** **AO4 1c**	1 mark for identifying a **suitable** property for the coat. 1 mark for explaining why the property is **suitable** for the coat. The property given may be appropriate, but if the explanation is not appropriate only one mark can be awarded. Answers must be **appropriate** for the context in the question: coat in image B.
4	(d)	(i)	**One** from: • effort • push • pressure.	**1** **AO4 1a**	**Do not accept:** applied force pull
4	(d)	(ii)	Linear	**1** **AO4 1a**	

Question			Answer	Marks	Guidance
4	(e)		Up to **two** marks for an explanation e.g. The bench is outdoors and hardwoods are generally better in outside weather conditions (✓), as softwoods generally need more treatment (✓) Other considerations might include: • softwoods generally need to be moved inside when the weather is wet • hardwoods generally more durable over a longer period of time • hardwoods generally much stronger when working with them • will drill well and hold the metal fixings onto the bench • generally less movement in different weather conditions • close grains of hardwood add compression strength in an open slat application. **Award credit for any other appropriate response**	**2** **AO4 1c**	1 mark for an explanation of why a hardwood is **appropriate** for the bench. 1 mark for a comparison to softwood. **Do not accept** hardwood is harder than softwood. Answers must be **appropriate** for the context in the question: Bench in image D.

Question			Answer	Marks	Guidance	
5	(a)		Indicative content of the most likely specific processes, tools, methods of accuracy, suitable finishing and materials for each product are shown in the table below. Allow step-by-step plans 1:1 or scaled final prototypes. The step-by-step plan should follow an appropriate order and should cover the following: **Materials and components**, e.g.; appropriate selection and preparation of specific materials and/or components. **Processes, techniques or skills, e.g.:** • *wasting methods* used to cut the materials (with allowances / tolerances as appropriate) – including accurate use of specific tools. • *deforming and reforming methods* used to shapes or strengthen materials and/or components – including accurate use of specific tools or equipment. • *methods of addition* used to join materials and/or components – including how	**12** **AO3** **2 x 1a** **1 x 2b** **AO4** **5 x 1c** **4 x 2c**	Candidates should present a clear step-by-step plan to demonstrate their understanding of the stages required to make a final prototype of their chosen product. If there is no evidence of an ordered plan, e.g. a list of unordered bullets they should not be rewarded with marks higher than a Level 1. Candidates can refer to manual, machine or CAD/CAM processes, but they must be appropriate for a school workshop not industrial manufacture. Candidates are not required to but may use sketches to support their answer. No marks should be awarded for the sketches themselves, but marks can be awarded appropriately for supporting annotation. _____ *A candidate operating at Level 3 could be accessing marks in a variety of ways. All but one of the AO4 marks and at least one of the AO3*	**Level 3 (9–12 marks)** The candidate demonstrates they have fully analysed the information given on the insert recognising all details required for making a final prototype. Their step-by-step stages will be comprehensive and well planned demonstrating excellent evaluation of how to undertake the making process. The candidate's plan will be fully detailed using appropriate terminology to demonstrate an excellent understanding of the workshop techniques and processes required to make their chosen product as a final prototype in a school workshop. They will demonstrate a thorough knowledge of how to work with specific tools and application of digital technology should be used (if appropriate). They should be clear on how to ensure a completely accurate outcome. Specific materials/components and finishes will have been clearly identified that are fully appropriate for both the processes being used and the prototype being made. **Level 2 (5–8 marks)** The candidate has adequately analysed the information given on the insert in that they have recognised some details required to make a prototype. Their step-by-step stages will be clear and some planning should be evident, demonstrating good evaluation of how to undertake the making process.

Question			Answer	Marks	Guidance	
			to ensure accuracy. **Tools and digital** technology, e.g.; all tools required to fulfil the processes and techniques being used. **Accuracy**, e.g.; appropriate measuring and marking /setting out and/or preparation of moulds, jigs, decoration or templates to ensure accuracy **Finishing**, e.g.; methods used for tidying up, preparing and finishing the materials / products so that they are suitable to be presented to a stakeholder.		*marks for planning their approach, or all AO3 marks and at least six of the AO4 demonstrating a broad knowledge and understanding of principles related to workshop skills.* *A candidate operating at Level 2 could be accessing marks in a variety of ways, but they should cover at least one of the AO3 marks for planning their approach and at least four AO4 marks, that sufficiently demonstrate enough of their knowledge and understanding of principles related to workshop skills.* *A candidate operating at Level 1 could be accessing marks in a variety of ways. They have not undertaken any analysis of the information on the insert, or planned their approach (AO3), but demonstrate some understanding of the materials and/or processes used to make a prototype(s), or they have done some analysis of the information (AO3) but have not demonstrated much*	The candidate's plan will offer some detail and use of appropriate terminology to demonstrate adequate understanding of the workshop techniques and processes required to make their chosen product as a final prototype in a school workshop. They will demonstrate a good knowledge of how to work with tools that may not always be specific and digital technology may be used (if appropriate). They should have some understanding of how to ensure accuracy in their outcome. Most specific materials/components and finishes should have been identified that are mostly appropriate for both the processes being used and the prototype being made. **Level 1 (1–4 marks)** The candidate has not fully analysed the information given in the Insert and/or planning is limited or not evident showing little evaluation of how to undertake the making process. The candidate's plan will lack any details and demonstrate a limited understanding of the workshop techniques and/or processes required to make their chosen product as a final prototype in a workshop. The response will demonstrate a basic level of skill and/or knowledge of the candidate in relation to their own workshop experiences and knowledge of tools and processes to offer little / no support to their response.

Question			Answer	Marks	Guidance	
					knowledge of the materials or making processes.	Specific materials/components and finishes may not be fully appropriate or identified. **Level 0 (0 marks)** No response or no response worthy of credit.

Indicative Content, e.g.:					
Product	**Specific materials and components**	**Processes, techniques or skills**	**Tools, including digital technology as appropriate**	**Ensuring accuracy**	**Finishing**
Product 1: Coffee cup (papers and boards)	• 130-170 (gsm) card • Cup board • Printing ink	• Creating the cup design layout • Preparing nets • Preparing a mould • Laser printing • Laser cutting	• Imagery software • Craft knife • CNC laser cutter • CMYK color system	• Measuring to scale • Marking out points • Colour alignment	• Plastic film lining • Application of design
Product 2: High visibility jacket (fibres and fabrics)	• fluorescent polyester and acrylic mixed fabric • reflective strips/tape • zip	• Pattern cutting pieces • Seaming • Overlocking • Applying a zip	• Sewing machine • Overlocker • Shears	• Cutting to a pattern / template • Ensuring suitable seam allowances	• Pressing under silicon mats. • Water resistant spray
Product 3: Customer satisfaction panel (design engineering)	• HIPS • Styrofoam • Components such as; PICAXE microcontroller, Arduino board, push to make switches • Glasspaper	• Soldering components • Making moulds • Using the moulds to vacuum form the casing	• Soldering iron • Vacuum former • Holesaw • IDE software to program the Java/Arduino	• Testing vacuum forming alignments • Templating components	• Sand and polish edges of plastic • Paint metal

Indicative Content, e.g.:					
Product 4: Retractable barrier (polymers)	• HIPS • Styrofoam	• Making moulds • Using the moulds to vacuum form the casing • 3D printing / laser cutting • Heat bending	• Files • Drill • CNC laser cutter • 3D printer	• Measuring to scale • templating	• File, sand and polish edges • Black paint
Product 5: Toilet sign (metals)	• Aluminium • Mild steel	• Bending panels • Welding /pop riveting sections together • Drilling holes to attach brackets • Applying imagery	• Pillar drill • Sheet metal bending machine • Arc welding machine	• Measuring to scale • Drilling/cutting templates	• Spray painting • Paints
Product 6: Flower planter (timbers)	• Pine • Fir	• Turning ball ends • Sawing and sanding • Doweling the ball ends	• Wood lathe • Jigsaw/bench saw • Pillar drill • Countersink bit	• Using jigs/templates for panel cutting/drilling • Using a lathe template	• Stain, varnish, preservative • Ensuring no sharp edges
Award credit for any other appropriate response acknowledging that materials that are suitable for a prototype may differ to those used to make the actual product.					

Question			Answer	Marks	Guidance
5	(b)	(i)	Up to **two** marks for an explanation e.g. User-centred design (✓) puts the user at the middle of the design process through explorations, discussions and collaboration (✓) so they are given full consideration during the development of a product. **Award credit for any other appropriate response**	**2** **AO4** **1 x 2a** **1 x 2b**	1 mark for identifying a suitable approach. 1 mark for an explanation of the intentions of the method.
5	(b)	(ii)	Up to **three** marks for an explanation e.g. Presenting prototypes to stakeholders allows for collaboration and gives the designer more feedback to support future iterations of their designs (✓), stakeholders may identify problems that the designer hadn't thought of themselves (✓), this ensures that the product is more likely to be sold (✓). Other stakeholder feedback of prototypes could include: • suggesting ways of marketing the product • identifying a unique selling point • identifying inaccuracies • obtaining reassurance that the design idea is viable. Other explanation of the importance could be: • ensuring the product is going to fulfil functional requirements • ensuring the product visually appeals to stakeholders. **Award credit for any other appropriate response**	**3** **AO4 2b**	Up to 2 marks for demonstrating their understanding of types of feedback stakeholders can offer. 1 mark for explaining why these are important.

Question			Answer	Marks	Guidance	
					Content	Levels of response
5	(c)		Inclusive considerations could cover: • height of information so people in wheelchairs are able to see things • size of text on displays and information so that they're easier to read by people with problems with their sight • lifts instead of stairs for people with movement disabilities • changing the trolley lock so that less effort is required to use it for people with arthritis • different coloured visibility jackets for staff who are there to help people with disabilities or the elderly so that they are easily identifiable • push buttons for opening doors • use of symbols / language • thinking about children. **Award credit for any other appropriate response**	**6** **AO3** **2 x 1a** **2 x 1b** **AO4** **1 x 1c** **1 x 2c**	Candidates are all required to use appropriate information from the insert to support their response. All responses should be in context to the train station. *A candidate operating at Level 3 should be accessing both AO4 marks, and at least three of the AO3 marks.* *A candidate operating at Level 2 could be accessing marks in a variety of ways. All AO4 marks with limited analysis or evaluation (AO3), or one AO4 mark supported by two AO3 marks.* *A candidate operating at Level 1 will be accessing at least one AO4 mark, but may access one AO3 mark.*	**Level 3 (5–6 marks)** The candidate will demonstrate good knowledge and understanding of inclusivity demonstrating an understanding of different groups of users e.g. disabled, the elderly or visually impaired. There will be able to demonstrate good analysis of products in the train station, and should have used this analysis to evaluate the importance of inclusivity when designing products. **Level 2 (3–4 marks)** The candidate will demonstrate good knowledge and understanding of inclusivity, this understanding may be limited to one group of users. There will be able to demonstrate some analysis of products in the train station, and may have used this analysis to evaluate the importance of inclusivity when designing products. **Level 1 (1–2 marks)** The candidate will demonstrate limited knowledge and understanding of inclusivity in relation to train station products, and may have made an attempt to analyse a product(s) in the train station. **Level 0 (0 marks)** No response or no response worthy of credit.

Question			Answer	Marks	Guidance
6	(a)		**One** mark for identifying an appropriate source and up to **three** marks for a description. In relation to the specific material stated. Answers could answers include: <u>Paper and boards e.g.</u> Source: Paper comes from trees (✓) They are felled and chopped up into pulp with water (✓) The pulp is put into a water-trough where a mesh will be used to collect it (✓). This is then pressed to extract the water and dried to make paper (✓). <u>Natural and manmade timbers</u> Sourced from tress (✓) and a description of the conversion to workable materials. (✓)(✓)(✓) <u>Ferrous and non-ferrous metals</u> Sourced from metal ores such as bauxite, gold and iron ore (✓), and a description of the its conversion to workable material. (✓)(✓)(✓) <u>Thermo and thermosetting polymers</u> Sourced from oils (✓) and a description of the conversion to workable materials. (✓)(✓)(✓) <u>Fibres and fabrics</u> Sources such as plants (cotton), animals, silk worms, oil, etc. (✓) and a description of the conversion to workable materials. (✓)(✓)(✓) <u>Design Engineering</u> Origins could link to any of the above materials (✓), but could also include the process of using a material to make a component. (✓)(✓)(✓)	**4** **AO4** **1 x 1a** **AO4** **3 x 1b**	**Do not credit** the specific material given. 1 mark for identifying appropriate source. The source must be appropriate to the specific material stated. Up to 3 marks for describing the specific stages and processes undertaken to convert and prepare the material in a workable form. Candidates are not required to but may use sketches to support their answer. No marks should be awarded for the sketches themselves, but marks can be awarded appropriately for supporting annotation.

Question			Answer	Marks	Guidance	
					Content	Levels of response
6	(b)*		Social ethical issues could relate to the use of a product, its materials or manufacture. Answers could cover: • sustainability considerations, such as: o cover sourcing, processing and depletion of virgin material. • social/ethical issues associated with sourcing material or processing, such as: o workers' rights and pay, fair trade, ETI o high temperatures, air and other pollution caused by processing etc… • moral and social issues could be environmental or economic factors, such as: o carbon footprint and transportation of materials and the product itself o disposal issues of waste products from processes and the impact on the local community/environment. <u>Paper and boards; Natural and manmade timbers</u> Issues relating to use of timber and paper/card based products such as deforestation, sustainable forests, (FSA). <u>Ferrous and non-ferrous metals</u> Workers in mines. Easy to recycle or from recycled source.	**8** **AO3** **4 x 2b** **AO4** **2 x 1c** **2 x 2c**	Candidates should be making the connections between social and ethical issues against environmental issues when selecting materials or components. Candidates who do **not** address both social and ethical issues cannot access Level 3. ——————— *A candidate operating at Level 3 should be accessing all AO4 marks and at least two of the AO3 marks, covering both social and ethical issues and connecting these to environmental impact.* *A candidate operating at Level 2 could be accessing marks in a variety of ways. All AO4 marks with limited evaluation (AO3), or a clear evaluation covering social and/or ethical issues which may be connected to environmental impact.* *A candidate operating at Level 1 will be accessing AO4 marks, but no AO3 marks.*	**Level 3 (6–8 marks)** The candidate will show good knowledge and understanding of social and ethical issues that are applied to the selection of materials for use. There should be good consideration of the environmental connection to these issues in relation to the life cycle of a product or environmental impact. They will be able to undertake a thorough evaluation of the issues identifying positive and negative implications. There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated with the use of examples. **Level 2 (3–5 marks)** The candidate will show good knowledge and understanding of social and/or ethical issues that are applied to the selection of materials for use. There will be some consideration of the environmental connection to these issues in relation to the life cycle of a product or environmental impact. There will be limited reference to

Question			Answer	Marks	Guidance	
					Content	Levels of response
			<u>Thermo and thermosetting polymers</u> Oil extraction, pollution, oil spills and depletion of supplies. <u>Fibres and fabrics</u> Fairtrade materials from sustainable sources; use of chemicals etc. <u>Design engineering</u> Components are hard to recycle or re-use due to the mix of materials.			evaluating the issues. Evaluations will be one sided or limited to one factor. There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence. **Maximum of 4 marks if no evaluation evident**. **Level 1 (1–2 marks)** The candidate will show limited knowledge and understanding of social or ethical issues that are applied to the selection of materials for use. There is no attempt at evaluation. The information has some relevance and is presented with limited structure or detail The information is supported by limited evidence. **Level 0 (0 marks)** No response or no response worthy of credit.

Assessment Objectives (AO) grid

Question	AO3	AO4
1a		3
1b		2
1c (i)		1
1c (ii)		2
1d (i)		2
1d (ii)		2
1e (i)		2
1e* (ii)	4	4
2a (i)		3
2a (ii)		3
2b		2
2c		2
2d		2
2e		4
3a		4
3b	2	2
3c (i)	1	
3c (ii)		2
3d	2	4
4a		2
4b		1
4c (i)		1
4c (ii)		2
4d (i)		1
4d (ii)		1
4e		2
5a	3	9
5b (i)		2
5b (ii)		3
5c	4	2
6a		4
6b*	4	4
Total	20	80
Overall Total	100	

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