

GCSE

Design and Technology

J310/01: Principles of design and technology

General Certificate of Secondary Education

Mark Scheme for June 2025

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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MARKING INSTRUCTIONS

PREPARATION FOR MARKING RM ASSESSOR

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *RM 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 available in RM Assessor.
3. Log-in to RM Assessor and mark the **required number** of practice responses (“scripts”) and the **number of required** standardisation responses.

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 RM Assessor 50% and 100% (traditional 40% 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 RM Assessor messaging system.
5. **Crossed Out Responses**
Where a candidate has crossed out a response and provided a clear alternative then the crossed-out response is not marked. Where no alternative response has been provided, examiners may give candidates the benefit of the doubt and mark the crossed-out response where legible.

Rubric Error Responses – Optional Questions

Where candidates have a choice of question across a whole paper or a whole section and have provided more answers than required, then all responses are marked and the highest mark allowable within the rubric is given. Enter a mark for each question answered into RM Assessor, which will select the highest mark from those awarded. *(The underlying assumption is that the candidate has penalised themselves by attempting more questions than necessary in the time allowed.)*

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).

When a question requires candidates to select more than one option/multiple options, then local marking arrangements need to ensure consistency of approach.

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 a more developed 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 the annotation 'SEEN' to confirm that the work has been seen and mark any responses using the annotations in section 11.

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 is not an attempt at the question.

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

8. The RM Assessor **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.**

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. For answers marked by levels of response: Not applicable in F501

To determine the level – start at the highest level and work down until you reach the level that matches the answer

To determine the mark within the level, consider the following

Descriptor	Award mark
On the borderline of this level and the one below	At bottom of level
Just enough achievement on balance for this level	Above bottom and either below middle or at middle of level (depending on number of marks available)
Meets the criteria but with some slight inconsistency	Above middle and either below top of level or at middle of level (depending on number of marks available)
Consistently meets the criteria for this level	At top of level

11. Annotations

Annotation	Meaning
BP	Blank page
	Point where mark is awarded
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

12. 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.

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.

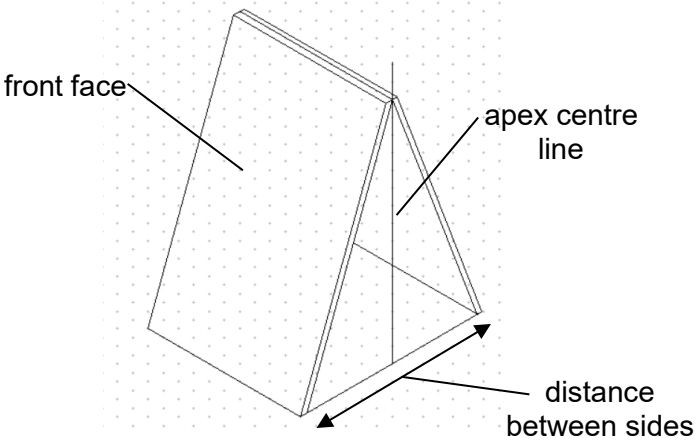
Be prepared to use the full range of marks. Do not reserve (e.g.) highest level marks 'in case' something turns up of a quality you have not yet seen. If an answer gives clear evidence of the qualities described in the level descriptors, reward appropriately.

Question			Answer	Mark	Guidance
1	(a)	(i)	Two from: • Can be moulded into shape • Comes in a range of colours – aesthetic appeal to user • Durable / impact resistant withstands wear and tear • Resistant to UV light and weather/ does not corrode • High strength to weight ratio • Lightweight so suitable weight when worn • Can be cleaned easily • Flexible so comfortable to wear / won't snap easily Award credit for any other appropriate response	2	Answers must be appropriate for the context in the question: Sunglasses Do not accept: cheap, answers relating to it being recyclable/sustainable Do not accept strong, durable, lightweight, aesthetic, unless qualified.
1	(a)	(ii)	One from: • Can be moulded into shape • Comes in a range of colours / textures / fashion trends • Water /weather resistant / does not corrode • High strength to weight ratio • Lightweight so suitable weight when worn • Can be cleaned easily • Durable so is impact resistant / not easily damaged Award credit for any other appropriate response	1	Answers must be appropriate for the context in the question: Sunglasses case Do not accept: cheap, soft and answers relating to it being recyclable/sustainable Do not accept: strong, durable, lightweight, aesthetic, unless qualified.
1	(b)		One from: • Can be sourced easily if replacements are needed. • It makes the product easier to repair. • They are familiar to users • Consistent manufacturing standards (always the same) • Lower cost than manufacturing yourself • Buy in bulk / cheaper / quicker than manufacturing yourself Award credit for any other appropriate response	1	Do not accept: cheap unless qualified

Question			Answer	Mark	Guidance
1	(c)		Two from: Lens could be made of a self-healing polymer (1) so the material would repair itself if scratched. (1) Shape memory alloy/polymers (1) could be used for the glasses frame or hinge so if the frame or hinges were bent out of shape/ damaged it could go back to shape. (1) A hydrophobic coating (1) to repel water and keep lenses Clear. (1) Be made from a phosphorescent material (1) so they glow in the dark and help safety/be seen at night. (1) Polymorph (1) could be used around the nose bridge to allow user to shape the glasses to fit more comfortably. (1) Made from a biopolymer (1) meaning less impact on the environment in sourcing the raw material for manufacture. (1) Thermochromic coating (1) used to change colour of the frame when the air temperature is colder/hotter. (1) Hydrochromic (1) used to change colour when exposed to water. (1) Self-healing polymer /coating (1) so scratches and abrasions don't spread. (1) Award credit for any other appropriate response	4	One mark for identifying/naming a specific smart or modern material One mark for explaining how it improves the design/ function sunglasses The question refers to the sunglasses. Max one mark per material if only the case is mentioned (2 MAX TOTAL) Do not accept Photochromic Accept other modern materials e.g. Kevlar, Graphene, D30, Carbon Fibre, Teflon, Flexiply, Lenticular plastic sheet, Precious metal clay (PMC), conductive polymers, GRP. Accept any technical textiles

Question			Answer	Mark	Guidance
1	(d)		Two from: • Make a model (1) of glasses frame to test comfort/ergonomics/ size on a user. (1) • CAD model in 3D (1) allows the design to be seen on screen to test appearance/aesthetics. (1) • Model of glasses with lenses (1) to test with a user and gain feedback. (1) • The lens component would be tested (1) to ensure UV resistance levels/weather resistance. (1) • Testing with light (1) to check lenses darken. (1) • Testing of folding mechanism/ hinge (1) to ensure it works and does not easily break. (1) • Testing the fit/ size of the sunglasses (1) in the sunglasses case. (1) • Anthropometric testing (1) to check fit / user comfort. (1) • User feedback on aesthetics/style (1) by showing them images (sketched or CAD) or physical models. (1) • Destructive testing (1) by dropping / pulling etc until they break. (1) Award credit for any other appropriate response	4	One mark for how to test One mark for why The question refers to the sunglasses. Max one mark per test if only the case is mentioned (2 MAX TOTAL) Accept any testing of usability, functionality, materials, size, aesthetics etc at design stage or for part of the product or of final product before production.

Question			Answer	Mark	Guidance	
					Content	Levels of response
1	(e)*		Discussion about the importance of considering fashion and trends when designing products may include: • How fashion and trends increase appeal to consumers through functionality or aesthetics desires. • How historical trends/fashions may impact future trends. • How fashion forecasters and trend predictions can predict future fashions. • How new technologies can create technological push and this can lead to market pull. • How marketing and social media can influence buyers and create trends. • Recent trends e.g. sportswear being worn in daily life, eco and ethical design becoming popular. • Colour, shape and style influencing aesthetics. • Materials and use of new and modern materials. • Styles that companies adopt, materials they use, branding and logos that are distinctive and how a company can become fashionable or trendy with groups of consumers e.g. Apple, Nike, New Balance, Miu Miu etc. Award credit for any other appropriate response.	8	Examples used could relate to consumer products and cover areas that have influenced popularity such as materials, technologies, colours etc	Level 3 (6–8 marks) The candidate will demonstrate an excellent knowledge and understanding of fashion and trends and how this helps companies to keep up with changing consumer needs. They will be able to discuss this convincingly, using examples of products to analyse and/or evaluate the importance of fashion, trends and changing consumer needs of products. 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. Candidates will be drawing on their wider understanding /experience of the whole subject through their exemplification. Level 2 (3-5 marks) The candidate will demonstrate some knowledge of fashion, trends and changing consumer needs. They will be a basic attempt to discuss/evaluate why fashion and trends are important. Any evaluation will be one-sided or limited in depth. There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence/examples. Candidates could be drawing on some of their wider understanding/experience of the subject. Level 1 (1–2 marks) The candidate will give a basic answer showing limited knowledge or understanding of fashion and trends and changing consumer needs. There is no attempt at evaluation. The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear/relevant. Level 0 (0 marks) No response or no response worthy of credit

Question			Answer	Mark	Guidance
2	(a)		Area of front panel LxW $800 \times 500 = 400,000 \text{ mm}^2$	1	Accept answers given with a different unit e.g. 0.4m^2 or 4000cm^2 but the correct unit must be clearly shown to award the mark.
2	(b)			4	Up to four marks from: • Front face drawn correct size 800×500 (1) • Correct apex position (on centre line) (1) • Correct distance between sides on floor (1) • Some thickness shown, at least two edges up to 1 square thick (1) do not award thickness if more than one square thick
2	(c)		Angle a = 40° 180 degrees in a triangle $70 + 70 = 140$ $180 - 140 = 40$	2	Correct answer scores full marks 180 degrees in a triangle 70° already shown, opposite angle must also be 70° $70 + 70 = 140$ $180 - 140 = 40$ 1 mark for an understanding of the total angle for a triangle = 180°
2	(d)	(i)	50% 15% 25%	1	All three must be correct for the mark to be awarded % sign does not have to be shown

Question			Answer	Mark	Guidance
2	(d)	(ii)	PLASTIC 50% GLASS 10% PAPERS AND CARDBOARD 15% PLASTIC PACKAGING 25%	3	Up to two marks for accurate representation of % for: Papers and Cardboard 15% Plastic Packaging 25% Plastic 50% 1 section correct = 1 mark 2 or more correct = 2 marks One mark for labelling all three parts (just names) or showing a key Accept different position of segments
2	(e)	(i)	$850 - 250 = 600\text{mm}$ (1) Conversion to m (600 converted to 0.6m) allow ECF (1) $0.6\text{m} \times 30 = \mathbf{18\text{m}}$ allow ECF (1)	3	Correct answer scores full marks
2	(e)	(ii)	$3\text{m} / 0.6 = 5$ arms per 3m length $30 / 5 = \mathbf{6}$ lengths needed (1)	1	
2	(e)	(iii)	$6 \times 9.75 = \mathbf{\pounds 58.50}$ (1) Answer from e(ii) ECF $\times \pounds 9.75$	1	Allow ECF from their answer in 2(e)(ii)
2	(f)		Up to two marks for a description e.g. Change in direction of force (1) Give mechanical advantage / make easier / reduce force or effort (1)	2	

Question			Answer	Mark	Guidance
3	(a)		One mark for each correct answer: The slider uses reciprocating (1) motion The crank uses rotary (1) motion	2	Accept rotation, rotational, rotating Do not accept circular, round
3	(b)		One from: • buzzer / bell / piezo • speaker • motor / servo • relay	1	Accept: bulb /lamp Do not accept: LED, battery
3	(c)		Two from: • The handle or toothbrush heads could be made from a biopolymer / recyclable plastic or bamboo material (1) to reduce impact on environment when sourcing materials. (1) • Use a different charging method (trickle / drip charge) (1) that uses less electricity. (1) • The toothbrush could use solar power (1) a renewable energy to charge the battery rather than mains electricity. (1) • The company could offer a recycling scheme (1) for the toothbrush heads to be returned to them for recycling. (1) • The toothbrush can be repaired (1) instead of being thrown away. (1) Award credit for any other appropriate response	4	One mark for a suggestion One mark for explaining how it improves sustainability Answers could cover – raw materials, energy during use or disposal.

Question			Answer	Mark	Guidance
3	(d)	(i)	AI is being used in products such as the toothbrush via apps (1) that monitor brushing habits and provide feedback. (1) AI is used in products such as Alexa/ Hive/Siri in smart phones (1) to recognise patterns and habits to enhance user experience by making suggestions. (1) AI controlled smart vacuum (1) that uses to scan room size, identify obstacles and remember the most efficient routes for cleaning. (1) Biometric technology/ fingerprints/ face recognition (1) used in smart phones and devices to improve security and make access faster. (1) Other applications could include Self-driving autonomous vehicles, RFID cashless sales / card transactions, route planners, AI controlled lawnmowers. Drone controlled cameras, ring doorbells, Smart (sonos or google home/ apple pod) speakers, air tags and GPS trackers. Technology could include VR, drones. IOT (Internet of Things), Nano technology, robotics, Award credit for any other appropriate response	2	One mark for a specific consumer emerging technology One mark for an explanation of how it helps the functionality. This can be for any product. Do not accept benefits for solely improving consumer experience/use Do not accept Bluetooth and 'old technologies' such as thermo/photochromics, CAD/CAM, laser cutter, memory foam, polymorph, wi-fi.
3	(d)	(ii)	Two from: Respond to technological push/ to keep up with competition from other companies. (1) Market pull/ people want new products / increase demand. (1) To sell more/ increase sales / popularity. (1)	2	Do not allow answers relating to 'increase functionality'

Question			Answer	Mark	Guidance
3	(e)		Discussion should include knowledge and understanding of the importance of designers considering inclusive design and may include: Inclusive design relates to barrier free use by all users e.g., children, adults, elderly, those with limited grip/ arthritis, left and right handers, partial or limited sight, colour blind, physical disabilities, language barriers, SEN needs and gender. User groups should be considered for understanding to be demonstrated. Failure to correctly understand inclusivity and consider inclusive design can result in products that cause unnecessary frustration and exclusion and can be hard or impossible to use. Examples could relate to small handheld products such as the toothbrush, garden tools, kitchen gadgets or larger products such as vehicles and furniture and may cover: • Use of colour e.g. neutral colours appeal to different genders. • Buttons and controls needing to be designed to be easily used by left hand/right handers or users with less mobility and limited grip/ arthritis. • Symbols can help people who are illiterate/ partially sighted or avoid language barriers. • User settings on mobile phones to improve inclusivity of the display on screen, size of text, colours and sounds to help those with limited sight or hearing. • height of products or signage so people in wheelchairs are able to use/see easily. Award credit for any other appropriate response	6	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 and should have used this analysis to evaluate the importance of inclusivity when designing products. Level 2 (3 - 4 marks) The candidate will demonstrate some 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 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/understanding of inclusivity in relation to products. No attempt at evaluation and any examples may not be appropriate. Level 0 (0 marks) No response or no response worthy of credit.

Question			Answer	Mark	Guidance
4	(a)	(i)	One from - It can be printed on - It can be recycled / is biodegradable so not harmful to the environment - It is low in cost/ widely available - Can be cut/shaped/folded easily - Lightweight so easy to carry Award credit for any other appropriate response	1	Answers must be appropriate for the context in the question: travel ticket Do not accept answers relating to durability
4	(a)	(ii)	220gsm	1	Do not award the mark if more than one answer is ticked
4	(b)	(i)	One from: - A mix of metals - Two or more metallic elements / metals	1	
4	(b)	(ii)	Two from: - It is lightweight and remains easy to move when loaded with luggage. - It has a good strength to weight ratio. - It is strong enough to support heavy luggage loads. - It is corrosion resistant if used or left outside. - It is durable so withstands wear and tear. Award credit for any other appropriate response	2	Answers must be appropriate for the context in the question: luggage trolley in a station Do not accept one-word answers e.g. strong, durable, lightweight, unless qualified.

Question			Answer	Mark	Guidance
4	(b)	(iii)	Up to two marks for one point explained e.g. • The trolley handle is curved / adjustable (1) making it comfortable to hold / push. (1) • The edges of the trolley are rounded/covered (1) making it safe to manoeuvre in busy transport hubs. (1) • The height of the handle (1) is comfortable for the average adult. (1) • Wheels on trolley (1) to allow it to be easily moved. (1) • Basket on trolley (1) allows small items to be stored leaving hands free to steer trolley / hold children's hands. (1) Award credit for any other appropriate response	2	One mark for an appropriate point One mark for explanation Answers must be appropriate for the context in the question: luggage trolley in a station and its ease of use/ comfort or efficiency
4	(c)	(i)	One from e.g. • Wooden lunchboxes are considered to be more ecofriendly/recyclable/sustainable/ biodegradable. (1) • They are aesthetically pleasing. (1) • They insulate food keeping it cold or warm. (1) • Softwood is a lightweight material to carry. (1) • They can be re-used instead of throwing away. (1) Award credit for any other appropriate response	1	Answers must be appropriate for the context in the question: wooden food container

Question			Answer	Mark	Guidance
4	(c)	(ii)	Two from: • Pine • Spruce • Cedar • Redwood • Larch • Fir • Yew Award credit for any other named softwood	2	Do not accept hardwoods

Question		Answer	Mark	Guidance
5	(a)	Up to two marks for describing how a working property of a material(s) in the product makes it suitable for the product. Two required. e.g.: PVC / laminated sheet Weatherproof (1) making it suitable for outdoor use (1) Can be printed on (1) the signage has graphics (1) Lightweight (1) keeps signage weight down for hanging it (1). Stainless Steel Resistant to wear & tear created when hanging (1) good tensile strength (1) won't rust/ corrode/ deteriorate if outdoors(1) Polyester fleece The polyester fleece is soft to touch (1) this makes the pillow comfortable (1). It is washable (1) so can be cleaned easily (1) Waterproof (1) so resistant to spillages (1) Memory foam High density means its resilient and durable so pillow will return to shape (1) Its classed as a smart material (1) and will return to its original shape after use (1) Brass Resistant to wear & tear/ durable enough for a moving part/ zip or popper (1) suitable for zip/ popper as won't corrode when its washed and stain pillow(1) Will not rust/corrode (1) zip/popper won't corrode and stop functioning (1) Polypropylene It has good chemical resistance and low moisture absorption (1) so suitable for use in electrical product/ or outdoors in weather (1). Flexible and hardwearing (1) for part that is clipped to the bike (1) Can be moulded into shape easily (1) low-cost material to keep unit cost low (1)	4	One mark for specific working property e.g. Hardness, tensile strength, malleable, insulator, can be moulded to shape, can be easily cut and scored, durable. One mark for relating this property to the chosen product.

Question			Answer	Mark	Guidance
			Acrylic Can be moulded into shape easily (1) low-cost material to keep unit cost low (1) it comes in clear/ transparent colours (1) so suitable for the light covering (1) PCB board (made of woven fibreglass and epoxy resin with copper tracks – electrical conductivity (1) so suitable for the circuit (1) ABS Toughness (1) to withstand impact makes suitable for helmet to protect head (1) Durable/ shatterproof (1) will withstand knocks (1) Lightweight (1) makes is suitable as a helmet worn on head (1) Expanded Polystyrene Lightweight/low density (1) easy to cut/shape / suitable for wearing on the head(1) Soft (1) makes it comfortable to wear (1) high compression strength/ high impact strength (1) make it a shock-absorbing material to protect the head (1) Polypropylene It has good chemical resistance and water resistance (1) so suitable for use outdoors in weather (1). Flexible and hardwearing (1) for part that is clipped/ moving(1) Can be moulded into shape easily (1) low-cost material to keep unit cost low (1) Nylon The nylon weave makes the strap durable (1) it is hardwearing and long lasting when in use/ won't break or snap easily (1). It is washable (1) so can be cleaned easily (1)		

Question			Answer	Mark	Guidance
			Aluminium It has a good strength to weight ratio (1) so is strong to hold user but adds minimal weight to the scooter (1) It is resistant to corrosion/ does not rust (1) making it suitable for outdoor use (1) Can be moulded/ cast (1) into an intricate shape with a quality surface finish e.g. footplate texture (1) Rubber Soft (1) so comfortable to touch for handles (1) Can be moulded into shape easily (1) low-cost material to keep unit cost low (1) Birch Dense material (1) strong in small sections (1) Flexible (1) so can be bent into shape (1) Good strength to weight ratio (1) Material is durable and lasts a long time with daily use (1) Available in plywood/ veneers/ layers makes the material stronger (1) and suitable to hold weight of a person (1) Mild Steel It is tough (1) and so when used in seat frame will withstand impact/ forces on people sitting (1) Malleable/ easy to form to shape (1) into section for frame (1) Award credit for any other appropriate response		
5	(b)		Two from: • Cost of material (1) • Availability of material (1) • Ease of sourcing raw material (1) • Carbon footprint/ sustainability / biodegradability (1) • How easy a material is to recycle/ recyclability (1) • The environment it will be used in (1) • Aesthetics / appearance of materials / colours (1)	2	Do not accept material / working properties

Question			Answer	Mark	Guidance
5	(c)		Two from e.g.: Banner signage One piece/ single sheet to make the banner means there are no joins that can weaken the product. (1) Taped edges add reinforcement to edges. (1) PVC / lamination makes material strong and durable/ resists cracking/ will not perish/deteriorate/degrade in hot/cold/wet weather. (1) Use of eyelet to reinforce area where string or chain to hang will be fixed. (1) Travel pillow One piece/ single sheet to make the pillow means there are no joins that can weaken the product. (1) Polyester as a material strong and durable/ resists tearing easily/ will not corrode in when washed. (1) The U shape/ domed cushion / helps hold the shape of the cushion when in use. (1) Bicycle light Moulded in pieces/ shell for strength. (1) Reinforced sections/ corners. (1) Shape/ Cross section of the clip parts T and I shape. (1) Bicycle helmet One piece/ monocoque structure. (1) Moulded into shell/ dome for strength. (1) Reinforced sections/ corners/ seams on buckle and strap. (1) Woven nature of nylon (under and over – warp and weft). (1) Children's scooter Textured material on foot plate adds reinforcement (1) Use of tubular sections adds strength (1) Welding on the frame ensures solid joint (1) use of a frame structure with pieces/ members joined (1)	2	Structural integrity/ ability to resist forces could include reference to: Structure types e.g. shell, mass or frame, use of triangulation and reference to shape, reinforcements such as webbing or double stitching. Do not accept properties. Do not accept repeats of information given on the insert unless the response states how the information improves the structural integrity. E.g. Doubled stitched makes seam twice as strong Joints bolted ensure parts stay together

		Modular seat Laminated pieces/ layers of material increase strength. (1) Use of a frame structure/ parts/ members joined to be structurally strong. (1) Used of the curves in sections create a dome effect which is strong. (1) Bolted joints give high strength and support. (1) Use of metal for the frame which is a strong material. (1) Award credit for any other appropriate response		
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Question		Answer	Mark	Guidance	Level of response
5	(d)	Product 1: Banner signage - (papers and boards) Cut with a craft knife, taped seams, vinyl cut or painted/ stencilled lettering/ printed in sections or a mix (due to size). Product 2: Travel pillow - (fibres and fabrics) Cut to shape, machine sewn and zip inserted, popper hammered or press stud gun used. Product 3: Bicycle light - (design engineering) Vacuum formed mainly in parts and fabricated wooden mould made, some thermoforming may be used, circuit soldered - copper strip or PCB board. Product 4: Bicycle helmet - (polymers) Vacuum formed, wooden mould made, Styrofoam used for EPS, strap riveted on. Product 5: Children's scooter- (metals) Fabricated from sheet and tubular steel, welded or pop riveted. Product 6: Modular seating - (timbers) laminated pieces formed individually using a male and female former, drilling for bolts, steel frame fabricated, small section made full size. Allow step-by-step plans or description of one or two production methods.	6	Candidates can refer to manual, machine or CAD/CAM processes, but they must be appropriate for a school workshop manufacture. The main part of the answer should cover the in-depth material area. 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 step-by-step plan or description of a process that may be used to manufacture the chosen product prototype (this should be full size or parts of it should be so it could be tested with users). If a model of the product is described using alternative materials than those given on the insert then full details of the model making process including appropriate materials, processes and joining techniques must be given.	Level 3 (5-6 marks) The candidate demonstrates they have fully analysed the information given on the insert recognising all details required for making their chosen product in a school workshop. Their process description will be comprehensive, demonstrating excellent understanding of the prototype manufacture processes using hand tools, machinery and CAD as appropriate. The candidate's response will be fully detailed using appropriate terminology to demonstrate an excellent understanding of the prototype manufacturing techniques and processes required to make their chosen product in the school workshop with specific tools and machinery and application of digital technology could be used (if appropriate). Materials/components and processes will have been clearly identified that are fully appropriate. Level 2 (3-4 marks) The candidate has adequately analysed the information given on the insert in that they have recognised some details required to make the product in a school workshop. Their description of processes will be clear and demonstrate a good understanding of the prototype manufacturing process. The candidate's response will offer some detail and use of appropriate terminology to demonstrate adequate understanding of workshop techniques and processes required to make their chosen product. They will demonstrate a good knowledge of how to work with tools and machinery that may

		Candidates can use diagrams to support this, it should follow an appropriate order and cover the following: Steps could include marking out, wasting, moulding, forming, assembly and finishing not all stages are required (product dependent) but steps covered should be detailed, e.g. wasting methods used to cut the materials (with allowances as appropriate) – including accurate use of specific tools. deforming and reforming methods used to shape/mould/ form materials and/or components – including accurate use of specific tools or equipment. specific methods of addition used to join materials and/or components how to ensure accuracy using jigs, templates and moulds and checking of sizes finishing techniques preparing and finishing the materials / products so that they are suitable to be presented to a stakeholder. Tools and digital technology could be used but response should cover all the tools required to fulfil the processes and techniques being used. Award credit for any other appropriate response		To gain level 3 the tools, materials and processes must all be appropriate and described in depth.	not always be specific, and digital technology may be used (if appropriate). Level 1 (1–2 marks) The candidate has not fully analysed the information given in the Insert and/or planning is limited or not evident showing little knowledge of the school workshop manufacturing processes. The candidate's response will lack any details and demonstrate a limited understanding of the manufacturing techniques and/or processes required to make their chosen product prototype. The response will demonstrate a basic level of knowledge. Specific materials, methods and techniques may not be fully appropriate or identified. Level 0 (0 marks) No response or no response worthy of credit.
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Specific techniques	Workshop processes, techniques, or skills could cover e.g.
Product 1: Banner signage- (papers and boards)	PVC vinyl sheet or another polymer such as HIPS, paper, cardboard or fabric sheet could be suggested. Creating the design layout on a computer, laser or inkjet printing or vinyl cutting of letters or laser cutting of stencils via CAM could be explained, the applying of vinyl decals, weeding, and mounting, use of low tack film or the painting/ stenciled lettering/ or printing in sections and cutting out letters and applying to a PVC sheet with spray mount or similar. Measuring and cutting sheet with a craft knife using a safety ruler, creation of taped seams - folding and double-sided tape applied. Cutting of holes and reinforcing with card rings or tapes could be suggested rather than eyelets.
Product 2: Travel pillow - (fibres and fabrics)	Polyester fleece fabric or similar would be suitable. Pattern or just cutting pieces with scissors after marking with tailor's chalk, suitable seam allowance, tacking and then stitching using a sewing machine, straight stitch. Applying a zip use of zip footer. Pressing with an iron. Then popper hammered, or popper stitched in place. They may also mention the foam pillow cut to shape using a craft knife.
Product 3: Bicycle light- (design engineering)	Vacuum formed from HIPS parts possibly three for light and fabricated - wooden mould made, some thermoforming may be used for clip etc., Vacuum forming – mould placed on platen and lowered, HIPS sheet clamped with toggle clamps, heated, heater pushed back and platen lifted and vacuum switched on, sheet takes shape of mould and cools, trimmed to shape with trimmer or knife and body assembled glued using DCM or Tensol Cement. OR the circuit soldering - copper strip or PCB board. Soldering iron tinned, components in board held with a clamp, components heated, solder applied neatly, components would include LED and polarity or checks when soldering should be expected if the response is purely for the circuit.
Product 4: Bicycle helmet - (polymers)	Vacuum formed from HIPS outer shape- wooden former made– mould placed on platen and lowered, HIPS sheet clamped with toggle clamps, heated, heater pushed back and platen lifted and vacuum switched on, sheet takes shape of mould and cools, trimmed to shape with trimmer or knife, holes drilled and a coping saw or abrafile could be used or a craft knife. OR Styrofoam used for EPS part/ or for a block model cut with a hot wire cutter or coping saw and sanded to shape – alternatively EVA foam could be vacuum formed before moulding the outer HIPS – they would be formed in layers then taken apart for cutting, strap could be riveted on. A bought in clip used.
Product 5: Children's scooter- (metals)	Aluminum or mild steel could be suggested. Fabricated from sheet and tubular steel, Welding /brazing/ pop riveting sections together – detail of cutting, bending, drilling holes, and marking out to drill should be expected. Use of scribes, centre punches etc, drilling, pillar drill or battery powered drill, clamping of work.
Product 6: Modular seating - (timbers)	Birch plywood 1.5mm thick or flexi ply/ or MDF most likely – a number of laminated pieces formed individually using a male and female former that would be made from wood or styrofoam, layers of wood are glued with PVA and sash clamps or G clamps, edges planed and sanded once formed. marking out for drilling for bolts, steel frame fabricated and bolted together. Small section made full size would access level 3.

Question			Answer	Mark	Guidance	
					Content	Levels of response
5	(e)		Response should identify processes and explain why they are suitable then cover the key steps to commercially manufacture the product. This could include: Banner signage– (papers and boards) Industrial guillotine – Materials are feed through rollers and cut to size suitable as it cuts identical/accurate pieces that are large. Digital printing/ screen printing is used the sheet is feed through a roller and the ink is printed sometimes UV digital printing but allow screen printing with use of a press. Both methods are suitable for large size prints and full colour prints, digital is more versatile for large runs. Travel pillow– (fibres and fabrics) Industrial die cutter or use of a pattern/ template and cutters for fabric or foam or Cutting pattern pieces using a band saw use of patterns marks out accurately cuts though several layers at once to speed up the production process. Industrial sewing machine/ overlocker to join seams and place zip. Poppers would be pressed or hammered into place – suitable for mass production.	9	Candidates can refer to manual, machine or CAD/CAM processes, but they must be appropriate for commercial production. The answer should cover the in-depth material and as a minimum the main part of the product. 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. Maximum Level 1 for a one-off product manufactured in a workshop rather than commercial production.	Level 3 (7-9 marks) The candidate demonstrates they have fully analysed the information given on the Insert recognising all details required for making the chosen product commercially. Their process(es) description will be comprehensive, demonstrating excellent understanding of the commercial manufacture process. The candidate's response will be fully detailed using appropriate terminology. to demonstrate an excellent understanding of the commercial manufacturing techniques and processes required to make their chosen product commercially. They will demonstrate a thorough knowledge of how to work with specific tools and application of digital technology should be used (if appropriate). Materials/components and specific processes/finishes will have been clearly identified that are fully appropriate for both the process(es) being used and the product being commercially produced. Level 2 (4-6 marks) The candidate has adequately analysed the information given on the Insert in that they have recognised some details required to make the product commercially. Their description of processes will be clear and demonstrate a good understanding of the commercial manufacturing process. The candidate's response will offer some detail and use of appropriate terminology to demonstrate adequate understanding of the commercial manufacturing techniques and processes required to make the chosen product. They will demonstrate a good knowledge of how to work with tools that may not always be specific and digital technology

		Bike light– (design engineering) Injection moulded suitable for moulding identical pieces that are complex and intricate can be made quickly and efficiently large run. Circuit – PCB board SMT is most likely- robotic pick and place machines then placed using a solder paste stencil will ensure speed and accuracy and minimal defects. Bike Helmet– (polymers) Vacuum formed can create a simple shape from a sheet material. Holes will be cut in after using a template and hot wire cutter. A number can be moulded at the same time to ensure accuracy using the same formers over and over (usually made of aluminium). Thermoforming the EPS is moulded using heat to melt granules/ beads and air is blown to expand the beads while heated and formed into shape by compressing two moulds together. Children’s scooter – (metals) The frame uses a tubular section that is cut to necessary length. It is a consistent and accurate cross section. Fabricated and welded frame using a series of templates and jigs in stages to ensure consistency, accuracy and speed. Footplate/deck if described likely to be cast (foot plate with texture). Die cast individually to shape or sand casting a large piece then cut to size and fabricated suitable for the shape and size and complexity.		(if appropriate). Materials/components and specific processes/finishes identified are mostly appropriate for both the process(es) being used and the product being commercially produced. Level 1 (1–3 marks) The candidate has not fully analysed the information given in the Insert showing limited knowledge of the commercial manufacturing processes. The candidate’s response will lack details and demonstrate a limited understanding of the manufacturing techniques and/or processes required to make the chosen product commercially. The response will demonstrate a basic level of knowledge and this may be in relation to their own workshop experiences and knowledge of tools and processes rather than a commercial level of production. Specific processes/finishes and techniques may not be fully appropriate or identified. Level 0 (0 marks) No response or no response worthy of credit.
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		Modular seating sections– (timbers) Laminated layers of wood are glued and formed in a mould then trimmed to size. Suitable for high level batch/ mass production of bent wood shape. The mould would be made from wood and reinforced with aluminium. Accept steam bending. Accept any other suitable commercial processes			
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Specific techniques	Commercial processes, techniques, or skills e.g.
Product 1: Banner signage - (papers and boards)	Industrial guillotine – Materials are feed through rollers and cut to size, guides feed material to keep it square. Digital printing or screen printing with use of a press - design printed onto a transparent film. A mesh screen is then coated with a layer of light-reactive emulsion, hardens when developed under bright light. Transparent film is then laid onto the emulsion-coated screen, and exposed to bright light to harden emulsion, then emulsion is washed off, creating the stencil. The screen is placed on the printing press. The ink is pressed through the screen onto the item, a squeegee is used to pull the ink along the full length of the screen. The product is dried to 'cure' the ink, checked and washed thoroughly to remove residue. Taping of edges by hand, eyelets pressed using a hydraulic press machine. Creating the design layout on a computer, using digital printing or even vinyl cutting of letters via CAM could be explained in a small batch run; details of setting up to print or cut/ speeds and feeds, the applying of vinyl decals, weeding etc. would be expected.
Product 2: Travel pillow - (fibres and fabrics)	Polyester fleece fabric or similar would be suitable. Industrial die cutter. Cutting pattern pieces using a band saw use of patterns marks out accurately cuts though several layers at once. Industrial sewing machine/ overlocker to join seams and sew zip; suitable seam allowance, tacking and then stitching using a sewing machine, straight stitch, steps of applying a zip use of zip footer. Pressing with an iron/press. Poppers would be pressed using a hydraulic press. Foam cut to shape using a bandsaw.
Product 3: Bicycle light- (design engineering)	Injection moulded – polymer pellets in a hopper are fed along a feed screw (Archimedean screw) heated and injected/ pushed under pressure into a mould. Moulds are made from stainless steel and are used repeatedly to ensure consistency. PCB board produced by photo etching, Print the circuit board and using UV light expose the copper board then etch this is usually ferric chloride solution -board in the acid tank for about 20 minutes until the copper traces are completely etched. You can tell that it's finished when the board turns from opaque pink to transparent yellow. Surface mounted components using pick and place method, held in place by a sticky solder paste then soldered in a reflow soldering oven and assembled into an injection moulded casing held in place by screws.
Product 4: Bicycle helmet - (polymers)	Vacuum formed – aluminum mould/former is used repeatedly, polymer sheet is fed through rollers and clamped. Trimming using templates/ guide template, mould placed on platen and lowered, HIPS sheet clamped with toggle clamps, heated until it softens, the heater pushed back and platen lifted and vacuum switched on, sheet takes shape of mould and cools, its removed from mould and then trimmed to shape with trimmer or knife, holes drilled – industrially this could be with a router. Candidate may include thermoforming the EPS moulded using heat to melt granules/ beads and air is blown to expand the beads while heated and formed into mould by compressing two moulds together.
Product 5: Children's scooter- (metals)	Tubes cut to length using hydraulic cutter. Ends of tubing prepared for welding – use of linisher. Fabricated and welded frame/ riveted together – pop riveting most likely, details of drilling jigs and welding jigs. Using a series of templates and jigs/ pipe benders in stages to shape parts into frame. Or, Cast (foot plate with texture). – Die cast individually or sand casting in a large piece then cut to size and fabricated – molten aluminium gravity fed into a steel die to die cast or poured into an open sand mould.
Product 6: Modular seating - (timbers)	Laminated layers of wood are glued using rollers to apply glue and formed in a mould. A wider section would be formed and then trimmed to size using a bandsaw or router, this is most suitable method for high level batch/ mass production of bent wood shape. Hydraulic press used. Routed or bandsaw to trim, edges planed and sanded once formed. marking out for drilling for bolts, use of a jig. Accept steam bending. If steel frame is referred to it is fabricated and welded/ bolted together.

Question			Answer	Mark	Guidance
6	(a)*		Discussion of lifecycle assessment (LCA) covering stages from raw materials to disposal could include: Environmental impacts associated with the chosen product during its life cycle at any point: • Sourcing of materials and their extraction, processing and manufacture will use energy and create pollution. • Manufacturing and assembly processes and finishing. • Transportation from factory to site and ongoing movement to maintain/repair. • Disposal at end of life – disassembly and recycling and how range of material and finishes used make this harder etc. Candidates should be drawing on specific materials/components or stages of life cycle to support their answer. Award credit for any other appropriate response	8	Level 3 (6–8 marks) The candidate will demonstrate an excellent knowledge and understanding of LCA stages and their impact on the environment when products are introduced. They will be able to discuss this convincingly, using examples of and/or evaluate the impact at specific stages of LCA. 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 some knowledge and understanding of LCA stages and their impact on the environment. There will be a basic attempt to discuss/evaluate the impact on the environment during use. Any evaluation will be one-sided or limited in depth. There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence/examples. Level 1 (1–2 marks) The candidate will give a basic answer showing limited knowledge or understanding of LCA stages and their impact on the environment. There is no attempt at evaluation. The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear. Level 0 (0 marks) No response or no response worthy of credit.

Product	LCA content guidance
Product 1: Banner signage e.g.	PVC polymer, produced from crude oil. Oil extraction releases greenhouse gases, and harms habitats and the environment. After the oil has been extracted it is transported to a refinery. Distilled oil is shipped to manufacturer, who creates polymer pellets. These are then manufactured into the PVC sheet by Calendering, a process that uses energy and heat. No energy is used to operate product; however, it will be cleaned occasionally, and detergents might be used. After its useful life, it will end up either being recycled or disposed of in landfill. In recycling, the PVC polymer is shredded and washed, then melted down and reformed into pellets that can be made into new products. The recycling process can also use lots of energy. The steel eyelets will have to be separated from the body and recycled separately.
Product 2: Travel pillow e.g.	Polyester polymer, produced from crude oil. Oil extraction releases greenhouse gases, and harms habitats and the environment. After the oil has been extracted it is transported to a refinery. Distilled oil is shipped to manufacturer, who creates polymer pellets. These are then manufactured into fibres by extruding through spinnerets to create long threads (called spinning). No energy is used to operate product. However, it will be cleaned/ washed, and detergents will be used. After its useful life, it will end up either being recycled or disposed of in landfill. In recycling, the Polyester fabric could be shredded and washed, then melted down and reformed into pellets that can be made into new products. The recycling process can also use lots of energy. The foam pillow and zip/ popper will have to be separated from the body and recycled separately.
Product 3: Bicycle light e.g.	Polypropylene polymer, produced from crude oil. Oil extraction releases greenhouse gases, and harms habitats and the environment. After the oil has been extracted it is transported to a refinery. Distilled oil is shipped to manufacturer, who creates polymer pellets. These are then manufactured into the product using injection moulding, a mould has to be made usually from stainless steel but this is reused. Battery power is used to operate product however they are rechargeable, so waste is minimal during the life of the light. It will be cleaned occasionally, and detergents might be used. After its useful life, it will end up either being recycled or disposed of in landfill. In recycling, the PP polymer is shredded and washed, then melted down and reformed into pellets that can be made into new products. The battery and components will be recycled separately. The recycling process can also use lots of energy. Circuit board removed, components de-soldered and reused.
Product 4: Bicycle helmet e.g.	Polycarbonate polymer, produced from crude oil. Oil extraction releases greenhouse gases, and harms habitats and the environment. After the oil has been extracted it is transported to a refinery. Distilled oil is shipped to manufacturer, who creates polymer pellets. These are then manufactured into the helmet moulding, a mould has to be made usually from aluminum but this is reused. No energy is used to operate product. However, it will be cleaned, and detergents might be used. After its useful life, it will end up either being recycled or disposed of in landfill. In recycling, the polycarbonate polymer is shredded and washed, then melted down and reformed into pellets that can be made into new products. The recycling process can also use lots of energy. The EPS inner shell and straps will have to be separated from the body and recycled separately.
Product 5: Children's scooter e.g.	Aluminum is made from Bauxite rock ores. Ores are obtained by mining, but to be turned into a form that can be used; it is ground and slurried with caustic soda and pumped through large pressure chambers this uses a lot of heat and energy. This process is known as Bayer process. It is then smelted into alumina to remove impurities. Electrolysis is used to smelter most aluminum these days, but this uses high temperatures and energy. Molten aluminum is formed into slabs, and ingots. The aluminum is then processed and rolled to form the tubular lengths and sheets. These will be transported to a manufacturing facility where the bar/sheet is cut, formed, welded, and riveted to form the chassis of the scooter. This is then spray painted or anodised. During its life it can be repaired or resprayed if needed. At the end of its useful life the aluminum can be recycled once any painted finish is removed. The wheels would need to be removed and might be reused. The rubber handles could be recycled but may end up in landfill.

Product 6: Modular seating e.g.	When a tree has been cut down, it is cut roughly into boards, planks, or veneer (conversion). Timber contains a lot of moisture which needs to be dried out before use, a process called seasoning. The planks of wood are stacked on top of each other so air can circulate between them and reduce the amount of moisture; usually done outdoors, this can take years, but timber can be dried faster using a kiln. Cutting trees down can lead to deforestation and soil erosion, forests need to be replanted to be sustainable. The seating is made using laminating, machinery to cut and shape the pieces and they are glued together and formed, sanded, and oiled. During its life it can be repaired or re-oiled if needed. After its useful life it could be sanded down to remove any surface finish and remade into something else or burned to create electricity. The oiled surface makes it harder to recycle. The steel frame and bolts would need to be removed before recycling but can be recycled separately.
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Question	Answer	Mark	Guidance
6 (b)	Up to two marks for each of two descriptions e.g. • Using fewer raw materials (1) by removing parts and/or reducing the amount of different materials. (1) • Sourcing materials and manufacturing locally (1) to reduce shipping and transportation/carbon footprint. (1) • Using recycled/reused materials/sustainable sources/materials that can be recycled/reused easily (1) examples such as sustainable forests/ bamboo or by using bio plastics derived from plants e.g. sugar cane or recycled polymers /ocean waste or recycled aluminium. (1) • Making the product easy to repair and or maintain (1) so it lasts longer. (1) • Avoiding surface finishes such as paint or special coatings/ dyes on fabrics (1) to aid recycling/biodegrading. (1) • Make products easy to disassemble (1) to improve ease of recycling. (1) • Make fabrics suitable to wash at low temperatures (1) to reduce energy consumption. (1) • Use less energy (e.g. handmade)/ less steps in manufacture (1) during the manufacturing process to lessen the use of energy. (1) • Energy efficient machinery or renewable energy (1) during the manufacturing process to lessen pollution and emissions. (1) Award credit for any other appropriate response	4	One mark for identifying a change e.g. less material, material that can be recycled etc. One mark for description related to the chosen product. e.g. making the bike light easy to disassemble, using an aluminium alloy for the scooter that can be recycled without the need for a surface finish or using a bioplastic instead of an oil based polymer for the banner or helmet, avoiding special finishes on wood or textile materials. Answers must be appropriate for the product – minimising its effects/impact on the environment. Do not accept ‘make it smaller’, ‘use less energy’ they need to be qualified.

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