Oxford Cambridge and RSA

GCSE (9–1)

Design and Technology

J310/01: Principles of design and technology

General Certificate of Secondary Education

Mark Scheme for November 2020

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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.

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

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)	i	**One** from: • Nylon • Polyester • PVC **Award credit for any other named synthetic fabric**	1	Do **not** accept any **natural** fibres/fabrics e.g. cotton or silk
	(a)	ii	Up to **two** marks e.g.: • Can be wiped clean/washed/washable • Can be engineered to be stain resistant • Crease resistant • Non absorbent / water & moisture resistant • Durable/long lasting/hard wearing/wear resistant • Breathable /moisture wicking/ quick drying **Award credit for any other appropriate reason**	2	1 mark for identifying a reason/characteristic of a synthetic fabric, that makes it suitable for the trainer upper. Answers must be **appropriate** for the context in the question: to support the function of a trainer upper. Do not accept generic properties such as strong / lightweight / flexible
1	(b)		Up to **two** marks for each of **two** benefits explained. e.g.: • Designers can incorporate 3D printing / rapid prototyping (allowing soles of trainers to be optimised) (1), this saves materials/creates a lighter shoe/ made to measure for the consumer/helps environment. (1) • New technologies are used to enhance the products performance/comfort (1) e.g. responsive cushioning • Virtual testing / reality simulates real life wear (1) • Sales can increase (1) due to unique features or enhancements to comfort/performance (1) • Allows designers to offer bespoke trainers/ made to order customised to suit the individual's requirements (1) manufacturers can offer more choice **Award credit for any other appropriate response**	4	1 mark for identifying a benefit e.g. customising or optimising. 1 mark for explaining the benefit Answers must be **appropriate** for the context in the question – design of trainers. Accept any appropriate benefit to designer, manufacturer or customer
1	(c)		Up to **two** marks for **one** reason explained e.g.: • They are not just a sports item (1) and are worn as a lifestyle shoe/ fashion item (1) • Lots of brands/product ranges (1) increases consumer choice/ options for all consumers (1)	2	1 mark for appropriate reason 1 mark for a justified explanation Answers must be **appropriate** for the context in the question: the popularity of trainers with consumers.

Question			Answer	Marks	Guidance
			• Available in many fabrics/colours/textures (1) so can be worn for different occasions/consumers own more than one pair (1) • Trainers are often celebrity endorsed (1) people like to follow celebrities (1) • Trainers are comfortable (1) and people often spend a long time on their feet so this is important (1) **Award credit for any other appropriate response**		

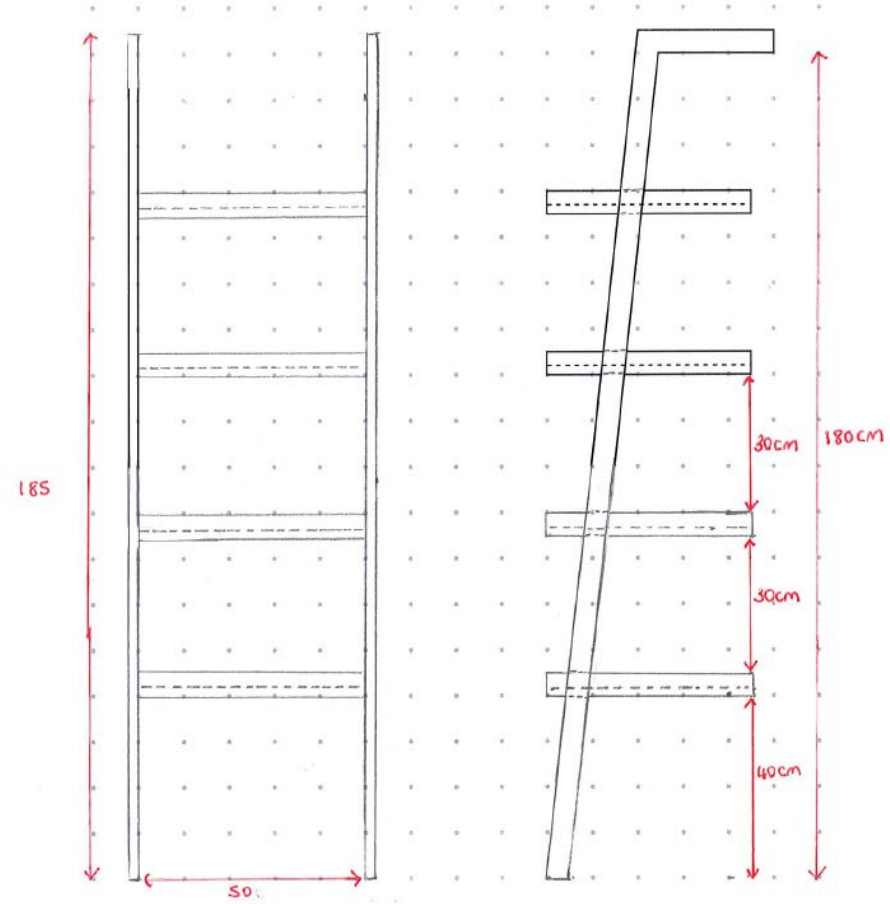
Question			Answer	Marks	Guidance
1	(d)		**One** from e.g.: • Easily moulded into shape to help the manufacturing process • Impact resistance so absorbs shock • Flexible so is comfortable • It is hardwearing/durable in use • It is waterproof to keep feet dry/used in all weather conditions/easy to clean • Chemical resistant **Award credit for any other appropriate response**	**1**	1 mark for a justified reason why a polymer is suitable for the trainer soles. Answers must be **appropriate** for the context in the question: to support the function of trainer soles.
1	(e)		**Two** from: • Raw materials are more readily available/cost less • Lower labour costs • Availability of factory space and skilled workforce • Ease of transportation globally • More advanced or efficient manufacturing processes • Corporate business taxes are lower • Less stringent regulations and standards **Award credit for any other appropriate response**	**2**	Award one mark for each correct answer No not accept: 'cheaper' on its own
1	(f)		Up to **two** marks for each of two issues explained e.g.: Issues could include: • Low standards for staff welfare • Sweat shops • Child labour • Low wages • Poor sourcing of material – sustainability and working conditions • Poor health and safety, long hours • Carbon footprint associated with transporting manufactured items globally	**4**	1 mark for each social or ethical issue identified that relates to manufacturing overseas 1 mark for a justified explanation of each issue. Must relate to social and/or ethical reasons.

			A company might consider a Fairtrade mark/ joining ETI (1) as it shows consumers they provide good working conditions for farmers and workers (fair pay and safe working practice.(1) Companies will need to consider how they can transport products sustainably (1) reducing/minimising their carbon footprint (1) Companies (such as Apple, Ikea, Primark, Zara and M&S) have schemes to monitor the social and environmental impacts of their business. (1) this reassures consumers (1) Need to trace the source of all its cotton, (1) child labour reported in all the major cotton-growing countries and some companies e.g. M&S recently committed to be sure they knew source of materials used (1) **Award credit for any other appropriate response**		PE to update at SSU – examples need to link to the issue and reflect acceptable answers that we may see in candidate responses.

Question			Answer	Marks	Guidance
2	**(a)**		360-260-90 = 10 allow ECF* (1) 180- 10*- 90 = 80° (1) OR Angle **a** = 80° (2) **Award credit for any other appropriate method of calculation**	**2**	1 mark for knowing angles at a point = 360° and correctly calculating missing angle. Allow ECF in the next step for their calculated angle if 10° not seen. 1 mark for knowing angles in a triangle add to 180 and for subtracting 90 (r/h triangle) and 10 (or their calculated angle) **If correct answer seen award full marks**
2	**(b)**	**i**	Length of top = 0.25 (m) Length of upright = 1.85 (m)	**1**	These are the only correct answers. Both need to be correct for 1 mark. ECF of their stated values to b (ii)

2	**(b)**	**ii**	Uprights: 1.85**/2.0= 0.925 so 1 upright per 2 m length therefore 2 x 10 = 20* lengths (1) Tops: 2 m/0.25** = 8 therefore 8 tops from each 2 m length (1) (2x10 =20) 20*/8 = 2.5 therefore need 3 lengths (1) Total = 20 + 3 = **23** (4) [**Max 3 marks if 22.5 seen**] Special case 1: • Correct calculations but for 10 side units = 12 - Award 3 marks Special case 2: • Correct calculation for making one set of side units = 3 and then multiplying by 10 = 30 - Award 2 marks **Award credit for any other appropriate method of calculation**	**4**	** ECF from (i) for their length conversion to metres 2 side units (top and upright) required per shelving unit, so 20 needed, either seen or implied* **If correct answer seen award full marks** 1 mark for calculating correct lengths for uprights (eg.1.85+0.25=2.1m) 1 mark for calculating correct number of sides (eg. 2.1m x 20) 1 mark for calculating number of tops that can be cut from one length (2.0/0.25 =8) 1 mark for calculating total number of lengths.
2	**(c)**	**i**	**One** from: • MDF • Plywood • Chipboard • Blockboard • Fibreboard • Hardboard **Award credit for any other named manufactured board**	**1**	Do not accept other manufactured boards such as cardboard, corriflute.

2	**(c)**	**ii**	**One** from e.g.: • Wider boards available • Uniform strength and characteristics across the board / no knots or grain • Cheaper than solid timber • Easier to cut • More resistant to warping or twisting **Award credit for any other appropriate response**	**1**	
2	**(d)**		18.40 x 40/100 = 7.36 (1) 7.36 + 18.40 = £25.76 (1) Or £25.76 (2) **Award credit for any other appropriate method of calculation**	**2**	**If correct answer seen award full marks**

Question			Answer	Marks	Guidance
2	(e)		Up to **four** marks for a correctly completed drawing: 	4	1 mark for completing the side by correct placement of the two bottom shelves and completing the correct the height of frame 1 mark for both sides projected from side view (candidates solution) to the front view (accept line less than 5mm for width) 1 mark for projecting the shelves (from candidates solution) onto front view 1 mark for showing thickness to the front view of the shelves (accept line less than 5mm)

Question			Answer	Marks	Guidance
3	(a)		The bicycle wheels turn around = **Rotary/ Rotational** The bicycle moves along the road in a straight line = **Linear**	**2**	1 mark for each correct answer. These are the only correct answers. Do not accept 'Circular'
3	(b)		Up to **two** marks for one reason explained e.g.: Gears allow for ease of cycling moving the chain from the smallest gear to the largest eases pedalling effort (1) they can make uphill easier. (1) It's efficient and having a much broader range, or choice, of gears for a given situation (1) e.g. a low gear to accelerate from a standstill, or to climb a hill, (1) Having a choice, of gears for a given situation (1) e.g. a high gear helps you to achieve high speeds. (1) To maintain a suitable pedal speed (1) in varying conditions/situations e.g uphill Mechanical advantage (1) through gears makes it easier to pedal / faster (1) **Award credit for any other appropriate response**	**2**	1 mark for a reason 1 mark for relating to effect on cycling
3	(c)	i	The driven gear will speedup/increase (1)	**1**	
3	(c)	ii	**One** mark e.g.: It allows the driver and driven gear to rotate in the same direction.	**1**	Allow one mark for can reduce friction as this is also correct

Question			Answer	Marks	Guidance
3	(d)		Up to **two** marks for an explanation e.g.: It can be adjusted to suit the users needs (1) to improve the bikes comfort/ ease of riding/ ergonomics/posture when riding. (1) The bike will last longer (1) as it can be adjusted as the user grows. (1) It can be used by multiple users/different people/family members (1) as it can be adjusted for different sizes of people. (1) **Award credit for any other appropriate response**	**2**	1 mark for a benefit 1 mark for a justified explanation of the benefit
3	(e)		5ft x12 = 60 inches + 10 = 70 inches (1) 70 x 2.54 = 177.80 cm* (1) Bicycle size = Large (1) ** ** Question states 'Show your workings' workings must be seen to support selection of bicycle size.	**3**	1 mark for calculating total size in inches 1 mark for converting to cm. 1 mark for correct bicycle size. Accept correct range 175-82 if large not seen This mark **can only be** awarded if working seen to support their choice of bicycle size. Allow ECF for their cm conversion when selecting bicycle size*
3	(f)		**Two** from: • Triangulation • Boning • Layering • Plastic webbing • Reinforcing • Choice of material and form e.g. tube or square section • Named joints that provide extra strength eg. dovetail **Award credit for any other process that provides structural strength**	**2**	Methods can relate to any material area.

Question			Answer	Marks	Guidance
3	(g)	i	Up to **two** marks for an explanation e.g.: An alloy combines at least two metals/materials (1) to improve the property characteristics e.g. makes the material stronger/lighter/resistant to corrosion (1) **Award credit for any other valid answer**	**2**	
3	(g)	ii	**One** from: • Carbon fibre/CF • Glass reinforced plastic/GRP • Kevlar **Award credit for any other named composite material**	**1**	

Question	Answer	Marks	Guidance	
			Content	Levels of response
3(h)*	Discussion should show understanding of the importance of considering renewable energy sources when designing and manufacturing products. Examples should be used to support their answer. Discussion could include: **Renewables** • Alternatives such as wind, solar, biomass, hydroelectric, wave, tidal and geothermal all being developed to be more efficient • Increasingly available. • Infinite. • 'Cleaner' compared to burning fossil fuels – reduce the rate of global warming e.g.: o Electric cars charged via renewable sources • Once set up energy is free and won't run out. • Can reduce pollution • Not able to completely replace fossil fuel energy supplies • Add to National grid supplied but more time needed to develop and improve infracture. • Designers/manufacturers can take some steps in using renewable power supplied e.g.: o Wind up radios/kinetic energy o Dynamos o Solar powered lights o solar panels on factory roofs	**8**	Candidates should be drawing on examples to support their answer. AO4: K&U = 4 AO3: Analysis &Eval = 4 A candidate operating at Level 3 should be accessing all AO4 marks and at least two of the AO3 mark analysing/evaluating renewable energy and its importance. 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 one particular impact of renewable energy and its importance. A candidate operating at Level 1 will be accessing AO4 marks, but no AO3 marks.	**Level 3 (6–8 marks)** The candidate will demonstrate an excellent understanding of the importance of renewable energy and its importance when designing and manufacturing. They will be able to discuss this convincingly, using examples of products that use renewable energy or sources of energy to analyse and/or evaluate the impact and why the right choice is important. 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 of products that use renewable energy or sources of energy. **Level 2 (3–5 marks)** The candidate will demonstrate some knowledge of renewable energy and its importance when designing and manufacturing. They will be able to discuss this, using example(s) of products that use renewable energy or sources of energy to analyse and/or evaluate its impact on the environment and what difference choices can make. 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 understanding of renewable energy sources. Any examples given may not be appropriate. Any attempt at analysis or evaluation of the choices made will be limited and not be worthy of credit. 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.

	Discussions might compare to non-renewable sources e.g.: • Oil, coal and gas running out/finite – need to find alternative. • Pollution caused burning fossil fuels • Oil spills, fracking etc • Natural habitats destroyed in extraction • Increase in green house gas emissions contributing to global warming.			

Question			Answer	Marks	Guidance
4	(a)	i	**Two** from e.g: • Fashionable and customisable • Lifestyle choice • Health choice • Wearable technology less devices need to be carried • Technology is smaller – miniaturisation **Award credit for any other valid reason**	**2**	One mark per reason Do not accept: lightweight, portable
4	(a)	ii	**One** from e.g.: • TPE • PET • HDPE • PVC • LDPE • PS • PP • ABS • Acrylic • HIPS **Award credit for any other named thermo polymer**	**1**	
4	(b)		**Two** from: • Focus groups • Surveys / Questionnaires • Interviews • User testing • Looking at existing products • Studying anthropometric data about users **Award credit for any other valid answer**	**2**	
4	(c)	~~i~~	**Two** from e.g.: • Easy to cut and fold • Easily printed on • Can be scored easily for bending • Lightweight **Award credit for any other appropriate reason why card is suitable for manufacturing packaging**	**2**	One mark for each property given related to suitability in **manufacture of packaging**. Do not accept: • cheap, strong, unless qualified • Answers relating to recycling • Impact resistant

4	**(c)**	**ii**	Up to **three** marks for an explanation e.g.: Choice of materials/specific packaging: • use of aluminum and steel for cans and tins as easy to recycle, avoiding mixes of materials so recycling is easier • use of glass easy to recycle or sterilse and reuse, • use of biopolymers made from starches, seaweed, fish waste, coconut husks etc. e.g. Coca-Cola plant bottle, also used by Heinz • compostable bags • use of recycled paper bags, recycled cardboard, both are easy to recycle, • natural materials such wool to insulate or protect rather than bubble wrap. **Award credit for any other valid answer**	**3**	1 mark for how 1 mark for giving a specific example of a product 1 mark a justified explanation of the how/example

Question			Answer	Marks	Guidance
5	(a)	i	Up to **three** marks e.g.: Scale of production: All products will be produced in batches or manufactured using JIT techniques. The batch maybe colour or design related and part of a higher level of production. Scale of production might relate to perceived demand of the product or reference to a chosen process making the level of production suitable. Indicative content e.g.: **Point of sale:** batch / mass production (1) design of box is used across other brands and variation of product. (1) The bars are produced in batches and the packaging is printed, tessellated to minimise waste and die cut to meet demand, bars are perishable so batch production suits (1). **Leggings:** batch / mass production (1) pattern pieces will be cut in batches and machine sewed in a production line which might break manufacture down into stages (1) produced in batches for size or colour variation and design, (1) **Weights machine** – batch / mass production (1) pulleys would be sourced and a brought in/ standard component, frames would be made using JIT manufacture in batches and possibly to order (1), allowing colours and branding to be changed. (1) **Step block** – batch / mass production (1) using injection moulding – the complexity of the mould and the volume of production (1) colour variations and branding can be applied (1) **Dumbell** – batch /mass production (1) – as sand casting is labour intensive (1) and demand for product would be on a small scale/ as weights are part of a set/can be branded (1)	**3**	One mark for stating level of production – batch or mass One mark for justifying suitability of process or reference to JIT/ production line or a specific process One mark for quality of justification relating to colour variations, size, branding etc Allow ECF for justification of the candidates chosen level of production if the explanation is correct max 1

			Lockers – batch produced (1)– JIT assembled on site due to size, supplied in flat pack form (1) colours, interiors and sizes can be altered to suit gym (1) **Award credit for any other valid answer**		

Question			Answer	Marks	Guidance	
					Content	Levels of response
5	(a)	ii	Explanation of the key manufacturing processes, including tools and techniques required to manufacture and assemble the candidates chosen product e.g.: **Point of sale display** Cardboard net printed, die cut and scored and perforated for folding. **Leggings** Cut and stitched overlocked and double seamed **Weights machine** Steel frame cut, bent and welded/riveted Nylon pulleys injection moulded **Stepper** Injection moulded with rubber insert. Accept vacuum formed for batch production. **Dumbbells** Casting (likely to be sand) but could be investment cast, machining on CNC lathe for handle to add screw thread etc **Locker**	**6**	Candidates are all required to use appropriate information from the Insert to support their response. All responses should be in context to the products listed in the Insert. Candidates can refer to manual, machine or CAD/CAM processes, but they must be appropriate for commercial manufacture and the scale of production they identified in part (i). 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.	**Level 3 (5-6 marks)** The candidate demonstrates they have fully analysed the information given in the insert recognising all details required for making their chosen product commercially. Their explanation will be comprehensive, demonstrating excellent understanding of the key manufacturing processes. They will demonstrate a thorough understanding of specific tools and techniques required to manufacture and assemble their chosen product. **Level 2 (3-4 marks)** The candidate has adequately analysed the information given in the insert in that they have recognised some details required to make the product commercially. Their explanation will offer some detail and use mainly appropriate terminology to demonstrate adequate understanding of the key manufacturing processes. They will demonstrate a good understanding of tools and techniques, although that may not always be specific, required to manufacture and/or assemble their chosen product. **Level 1 (1–2 marks)** There is limited analysis the information given in the insert showing little knowledge of the commercial manufacturing processes.

			Cutting, routers possibly CAM, knockdown fittings and joints Allow step-by-step plans or description of one or two production methods. A step-by-step plan or description of a process that may use diagrams to support this, should follow an appropriate order and should cover the following: 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 shape/mould or strengthen materials and/or components – including accurate use of specific tools or equipment. • *methods of addition* used to join materials and/or components. **Tools and possibily digital** technology, e.g.; all tools required to fulfil the processes and techniques being used.			The candidate's response will lack details and demonstrate a limited understanding of the key manufacturing processes. The response will demonstrate a basic level of understanding 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, tools and techniques may not be fully appropriate or identified. **Level 0 (0 marks)** No response or no response worthy of credit.

Product	Specific materials and components	Processes, techniques or skills
Product 1: Point of sale display (papers and boards)	Cardboard box	• could be CNC cut • Die cutting – a steel die is lowered cardboard and pressed to cut out the shape and the perforations a blunt or rounded blade is used to make scores • Glue applied to tabs and finished box is flat packed to be assembled in situ when bars are packed
Product 2: leggings (fibres and fabrics)	Lycra leggings	• Pattern cutting pieces with band saw • Seaming with industrial sewing machine and over locker • automated press or steam dolly • double stitching of seams
Product 3: Weights machine (design engineering)	Polymer pulley wheel Steel frame	Injection moulding the pulleys– plastic injected into a mould using a ram or injection screw. Die/ Mould is made of steel. Continuous process • cutting and forming steel bars mechanical hacksaw or plasma cutters • forming of tubes by extrusion, bending of tubes to shape, drilling for rivets and nuts and bolts • Welding /pop riveting sections together, use of nuts and bolts
Product 4: Step block (polymers)	PP	• injection moulding /vacuum forming plastic injected into a mould using a ram or injection screw. Die/ Mould is made of steel. Continuous process, rubber part made separately by injection moulding, die cutting and placed into die/mould and injection moulded
Product 5: Dumbbell (metals)	Cast iron Stainless steel	• casting the dumbbell – sand casting • former made probably aluminum with quantity and sand moulds prepared, compacted sand, runner and riser, ingots heated in a crucible and molten metal poured in a mould, finished removal of runner and risers • machining the handle, CNC lathe would be used – turning, turning down and cutting thread
Product 6: Locker (timbers)	MDF	• wood cut and drilled with bandsaw, drill jig or CNC router and shaped and surface finish applied • use of jigs and templates, KD fittings bought in as standard components • flat pack and use of KD fittings to assemble on site

Question	Answer	Marks	Guidance

5	**(a)**	**iii**	Up to **three** marks for a description e.g.: **Point of sale:** nets are tessellated and printed – use of registration marks if appropriate. A steel die is used to cut, perforate and score the net this will enable batch production to be accurate. Folding and glue applied – net assembled and checked at packing stage **Leggings:** pattern pieces are used to ensure consistency. Leggings will be QC checked at stages against pattern, the use of a production line ensures consistency and identification of faults at various stages, footer and settings on machine set for stitch size, length etc **Weights machine:** pulleys would be sourced and a brought in/ standard component this means consistency over batch, frames would be made using JIT manufacture in batches, cutting, bending and drilling jigs would be used, assembly of mechanisms would be tested and lubricated once assembled to ensure functionality. If the pulley is covered the process would be same as step block below **Step block:** Steel die would be used to ensure consistency when injection moulding, colour variations and quality of plastic would be QC checked visually, any flashing removed. Assembly would need to be tested to check for dimensional accuracy **Dumbell:** pattern made from aluminium for reuse in sand casting. Final casting would be checked for quality and machined appropriately, handles would be cut to length and knurled using a CNC lathe to ensure consistency **Lockers:** Standard KD fittings ensure consistency, use of CNC routers to cut and drill pieces accurately. JIT assembled on site and checked during assembly and fitting **Award credit for any other valid answer**	**3**	Candidates description may cover more than one process for their chosen product.

Question			Answer	Marks	Guidance	
					Content	Levels of response
5	**b**		Indicative content of the most likely specific areas covered in sourcing of raw materials and processing/converting into a useable form. • Raw materials are extracted or harvested. • Raw materials then go through a number of manufacturing steps until material is a useable form. • Processing raw materials involves transforming raw materials by chemical or physical processing methods, for example, smelting and converting ores into usable materials, making polymers from oil.	**6**	Candidates should present a description to show knowledge and understanding of the stages required to source and process their chosen raw material. If there is no evidence of an ordered description, e.g. a list of unordered points they should not be rewarded with marks higher than a Level 1.	**Level 3 (5-6 marks)** The candidates will demonstrate an excellent understanding of the processes required to source and convert their chosen raw material into a useable form. Their description will be in-depth, using appropriate terminology and show a clear and logical understanding of the required stages to process the raw materials into a useable form. **Level 2 (3-4 marks)** The candidates will demonstrate some understanding of the processes required to source and convert their chosen raw material into a useable form. Their description will provide some detail, use mostly appropriate terminology and mostly show a logical understanding of the required stages to process the raw materials into a useable form. **Level 1 (1–2 marks)** The candidates will give a basic answer showing limited understanding of the processes required to source and convert their chosen raw material into a useable form. Their response will lack detail and may be little more than a list of unordered points. **Level 0 (0 marks)** No response or no response worthy of credit.

Product	Sourcing and processing of raw materials
Product 1: Point of sale packaging (papers and boards)	Card is made from trees – raw wood chippings are pulped by soaking them in water and pulverising Pulp is pressed through a series of rollers to become paper. Chemical processes to pulp use caustic soda and sodium sulphate to break down wood fibres or mechanical pulping takes place, other fibres can be added, bleached, coloured or high quality paper/board is made this way. Card is made by sandwiching layers of paper or by pressing wet layers of pulp to make a thicker board. Sometimes a mixture of recycled paper/card and new virgin wood are used to make pulp
Product 2: Lycra leggings (fibres and fabrics)	Synthetic fabric is produced from crude oil. Crude oil is fractionally distilled and the chemicals needed to make polymers are obtained, catalysts are added to enable polymerisation the joining together of monomers. Additives can be added to improve properties. Polymer solution or melted pellets are used. These are then manufactured into fibres using the extrusion process – a spinneret it used to form solution into long fibres and allowed to cool, the fibres are wound on to bobbins for further processing. Leggings will be made by bonding fabric using long and short fibres. Some of the short portions of the polymers bond with each other and give the fibre structure, force is applied to stretch the fibre the bonds between the short fibres are broken, and the long segments straighten out, creating an elastomer material. Spandex fibres (lycra) make leggings use mainly polyurethane fibres.
Product 3: Weights machine (design engineering)	Metal frame steel made from iron ore. Mould for injection moulding is also steel. Ores are dug out of the ground by mining, but in order to be turned into a metal form that can be used they must be separated from whatever they are mixed with. This process is known as extraction. A mixture of iron ore and coal is then heated in a blast furnace to produce molten iron, or pig iron, from which steel is made. Molten steel from the furnaces passes through continuous casters and is formed into slabs, and billets. The steel is then processed and rolled to form the tubular steel lengths. Nylon produced from crude oil. After the oil has been extracted it is transported to a refinery. Crude oil is fractionally distilled and the chemicals needed to make polymers are obtained, catalysts are added to enable polymerisation the joining together of monomers. Additives can be added to improve properties. Distilled oil is shipped to a manufacturer, who creates polymer pellets.
Product 4: Stepper (polymers)	Polypropylene polymer, produced from crude oil. After the oil has been extracted it is transported to a refinery. Crude oil is fractionally distilled and the chemicals needed to make polymers are obtained, catalysts are added to enable polymerisation the joining together of monomers. Additives can be added to improve properties. Distilled oil is shipped to a manufacturer, who creates polymer pellets. Synthetic rubber also made through polymerisation.
Product 5: Dumbells (metals)	Cast iron and steel is made from iron ore. Ores are dug out of the ground by mining, but in order to be turned into a metal form that can be used they must be separated from whatever they are mixed with. This process is known as extraction. A mixture of iron ore and coal is then heated in a blast furnace to produce molten iron, or pig iron, from which steel is made. Cast iron can be made directly or by re-melting pig iron with substantial quantities of iron, steel, limestone, carbon (coke) to remove any contaminants. Molten steel from the furnaces passes through continuous casters and is formed into slabs, and billets. The steel is then processed and rolled to form the steel bar lengths for the handle which is then machined or cast into ingots.
Product 6: Locker (timbers)	When a tree has been cut down, it is cut roughly into boards, planks or veneer (conversion). Timber contains a lot of moisture, dried out before use, a process called seasoning. The planks of wood are stacked on top of each air can circulate between them and reduce the amount of moisture usually done outdoors, can take years but timber can be dried faster using a kiln. MDF board is made by compressing tiny wood particles/fibres and adhesive together.

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>5</td><td>(c)</td><td>i</td><td>
One mark for each of two features e.g.:
<table>
<tr>
<td>1. Point of sale display
• Easy to access bars/ large enough for hand
• Nutritional and health information clearly communicated, font size and type
• Ease to assemble in shop</td>
<td>2. Leggings
• Drawstring around waist can be adjusted for different sizes
• Thick waistband for comfort
• Nylon with elastane for easy movement and comfort
• Fits body securely no loose parts that might be a trip hazard etc</td>
</tr>
<tr>
<td>3. Weights machine
• Texture of grips
• Size of grip handles and shape for comfort
• Adjustable seat/surface
• Padded seat/surface for comfort
• Colour coding on handles for ease of understanding how to adjust</td>
<td>4. Stepper
• Use of colour to show separate parts
• Grip of top step
• Lightweight to carry
• Easy to assemble
• Wider base for stability in use
• Size of step surface in relation to foot</td>
</tr>
<tr>
<td>5. Dumbell
• Grip of handle and polymer rubber handle adds comfort
• Rounded edges on weight plates
• Ease of use – screw thread
• Labels cast into weight to identify size/weight
• Thickness of plate easy to hold</td>
<td>6. Locker
• Colour of doors stands out
• Height of locker
• Size of door
• Size of buttons</td>
</tr>
</table>
Award credit for any other valid answer.
</td><td>2</td><td>Two ergonomic features needed relevant to chosen product.</td></tr>
</table>

<table>
<tr>
<td>5</td>
<td>(c)</td>
<td>ii</td>
<td>One mark for each of two examples e.g.:
<table>
<tr>
<td>1. Point of sale display
• Hand width/length
• Eye/sight line
• Arm length</td>
<td>2. Leggings
• Width of waist or hip/buttock
• Length of leg
• Size of grip related to zip or drawstring</td>
</tr>
<tr>
<td>3. Weights machine
• Width of buttock
• Hand size grip
• Hand width
• Arm length</td>
<td>4. Stepper
• Width of buttock
• Size of foot
• Size of hand/grip for carrying
• Weight of a person</td>
</tr>
<tr>
<td>5. Dumbbell
• Width of hand
• Grip of hand size
• Finger width</td>
<td>6. Locker
• Size of hand
• Height of person</td>
</tr>
</table>
Award credit for any other valid answer.</td>
<td>2</td>
<td>Two examples needed must:
• be relevant to chosen product
• involve size or weight of humans</td>
</tr>
</table>

Question			Answer	Marks	Guidance
6	(a)		**One** mark for each of two reasons e.g.:	2	Two reasons needed they must be: • relevant to a material and/or surface finish for the chosen product • link to making it suitable for the products intended purpose

1. Point of sale display

Cardboard:
- Can be printed on easily
- Stiff, hard and durable in use
- Can be assembled into a net
- The card has a gloss finish on the printed areas.

Wrapper:
- Can be printed on
- Keeps the food fresh when sealed

2. Leggings

Nylon with elastane:
- Can be washed easily
- Available in a range of colours and patterns
- Stretch allows comfort in use
- Durable material, does not tear or break easily

3. Weights machine

Nylon
- Self-lubricating
- Easily moulded of formed
- Doesn't corrode
- Does not need a surface finish as self finishes

Steel frame
- Inexpensive compared to other metals
- Available in box sections or tubular forms
- Tough and durable
- Easy to cut, drill and weld
- Painted, plastic coated or powder coated finish
-

4. Stepper

Polyethylene (PP)
- Range of colours
- Tough, flexible
- Good chemical resistance
- Can be easily moulded
- Does not need a surface finish as self finishing
- Good grip

- **Dumbbell**

Cast iron

5. Locker

MDF

			• Heavy • Can be cast • Compressive strength • Relatively low cost compared to other metals • Painted, plastic coated or powder coated finish Hammertone finish: • Cover imperfections in casting process • Protects from sweat. **Stainless Steel** • Inexpensive compared to other metals • Tough and durable • Doesn't corrode • Can be machined • Surface is shiny and hard no further finish is needed	• Laminate is very tough and durable • Uniform characteristic • Withstands wear and shock • Takes a paint or surface finish well • Can be painted usually applied by spray or plastic coated or an MF surface covering applied with lipping/edging and a laminate could be applied		
			Award credit for any other valid answer.			

Question			Answer	Marks	Guidance
6	(b)		Up to **three** marks for a description e.g.: **Point of sale -** Logo and branding produced on a computer and printed using digital / flexography / offset lithography (1) surface finishes eg.varnishing, hot oil, embossing **Leggings -** designs produced and fabric printed at the polymer stage to avoid fading or using direct sublimation after an image is produced digitally heat and pressed (1) – logo applied by transfer or screen printing or embroidered using CNC sewing machine (1) (1) **Weights machine –** spray painted / powder coated / lacquered finish (1) and the hammertone applied. (1) Or/ The nylon and polymer parts are self-finishing (1) but colour pigment is added at the moulding stage (1) (1) **Step block –** Self finish from mould – trimmed by hand. Logo incorporated into injection moulding tool or applied after forming the step by screen printing or heated die (1) the logo is created using different colours or textured and by detail in the steel tool (1) **Dumbell –** spray painted / powder coated / lacquered finish (1) and the hammertone applied. (1) Polishing (1) or metal plating (1) **Lockers –** a plastic melamine (MF) finish is laminated (1) a press or heat press is used (1) Spray paint finish to MDF (1) Logo applied by screen printing / engraving (1) **Award credit for any other valid answer.**	**3**	Allow any suitable / appropriate method of finish or applying a logo to the product. Allow vinyl stickers for logo application to all products except leggings.

Question	Answer	Marks	Guidance	
			Content	Levels of response
6(c)*	Discussion could include • A brand or logo can be fashionable and can influence a purchase of branded items over non branded. • Customers feel loyal to brands, they know what they are getting and are often willing to pay more for branded goods • Celebrity endorsement of brands can influence people • Brands are advertised or marketed more, this can be in newspapers and magazines, through TV adverts or product placement in films • Brands can sometimes be a status symbol or reflect a cultural style or trend • Customers buy into the brands ethical values e.g. eco brands such as the Adidas parley range Examples could include Nike, adidas, Under Armour, Apple, Coca-Cola etc but do not have to be sports brands Discussion should include knowledge and understanding of the impact of branding in relation to consumer purchases – answers may relate to a gym or sporting environment but do not have to.	8	Examples of both good and bad use of the marketing/branding of products should be provided to aid their discussion. AO3 Evaluation = 4 marks AO4 K&U = 4 marks A candidate operating at Level 3 should be accessing all AO4 marks and at least two of the AO3 mark evaluating the importance of marketing and branding. A candidate operating at Level 2 could be accessing marks in a variety of ways. All/most AO4 marks with limited evaluation (AO3), or a clear evaluation around one particular example of marketing/branding A candidate operating at Level 1 will be accessing AO4 marks, but no AO3 marks.	**Level 3 (6–8 marks)** The candidate will demonstrate an excellent understanding of why marketing and branding is important in the design of products and how this influences consumer decisions. They will be able to discuss this convincingly, using examples of products to evaluate the importance. 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 understanding why marketing and branding is important in the design of products and how this influences consumer decisions. They will be able to discuss this, using example(s) of products to provide some evaluation of the importance. There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence. **Level 1 (1–2 marks)** The candidate will give a basic answer showing limited understanding of why marketing and branding is important in the design of products and how this influences consumer decisions. Any examples given may not be appropriate. Any attempt at an evaluation will be limited and not be worthy of credit. Any 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.

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