GCSE

Design and Technology

J310/01: Principles of design and technology

General Certificate of Secondary Education

Mark Scheme for June 2024

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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.

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 Assessor Online Training*; *OCR Essential Guide to Marking*.

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

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

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

MARKING

1. Mark strictly to the mark scheme.

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

3. The schedule of dates is very important. It is essential that you meet the 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 or the RM Assessor messaging system, or by email.

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.

   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 a tick to confirm that the work has been seen.

7. Award No Response (NR) if:
    - there is nothing written in the answer space

    Award Zero '0' if:
    - anything is written in the answer space and is not worthy of credit (this includes text and symbols).

    Team Leaders must confirm the correct use of the NR button with their markers before live marking commences and should check this when reviewing scripts.

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.**
    If you have any questions or comments for your team leader, use the phone, the RM Assessor messaging system, or e-mail.

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:
    a. **To determine the level** – start at the highest level and work down until you reach the level that matches the answer
    b. **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

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.

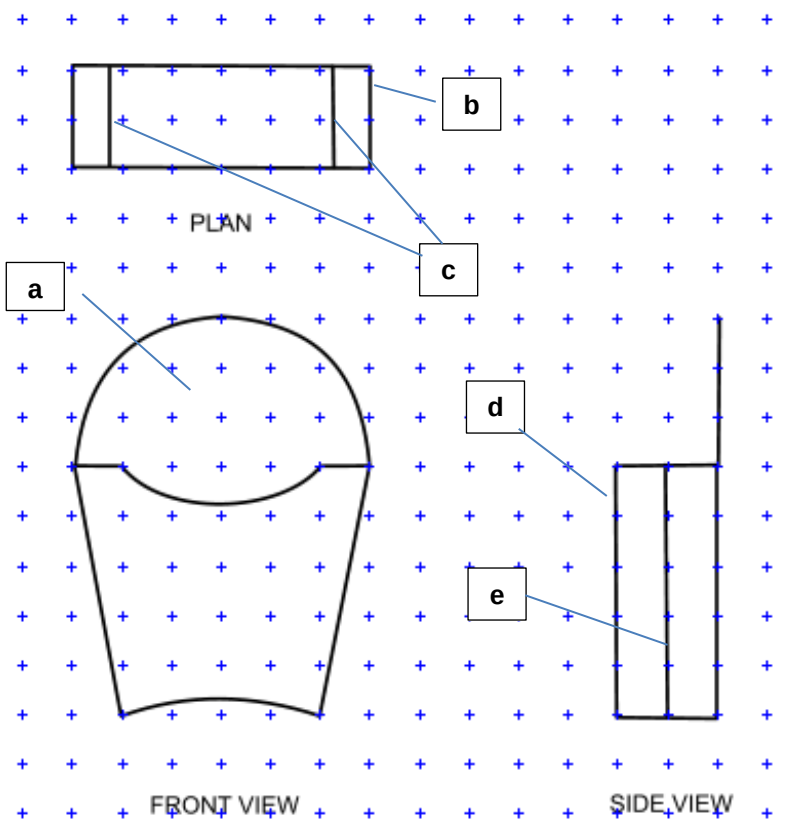
Using 'best-fit', decide first which set of level descriptors best describes the overall quality of the answer. Once the level is located, adjust the mark concentrating on features of the answer which make it stronger or weaker following the guidelines for refinement.
Highest mark: If clear evidence 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.

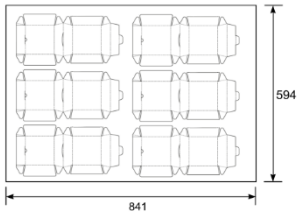
Be prepared to use the full range of marks. Do not reserve (e.g.) highest level marks 'in case' something turns up of a quality you have not yet seen. If an answer gives clear evidence of the qualities described in the level descriptors, reward appropriately.

Question			Answer	Mark	Guidance
1	(a)	(i)	**One** from: • Cedar • Fir • Pine • Redwood • Spruce • Larch	1	Accept any other named **softwood** Do **not** accept hardwoods
1	(a)	(ii)	T**wo** from: • It has good rot resistance/ resistance to weather **if treated** • It is easy to machine / work with • It is attractive due to grain/ its natural finish	2	Answers **must** be appropriate for the context in the question: **Playground equipment** Do not accept: water resistant, readily available, Do not accept generic one word answers without qualification eg. Strong, durable, cheap
1	(b)		**Two** from: • Resistant to wear / hard wearing / durable • Resistant to corrosion • Resistant to heat and fire • Low maintenance/easy to clean • Impact resist / high tensile strength • It is aesthetically pleasing	2	Answers **must** be appropriate for the context in the question: **Chains that help attach the mast to the playground sailing ship** Do not accept generic one word answers without qualification eg. Strong
1	(c)		Surface area: **1** (m^2) Area of triangle = half base x height or calculation of area of rectangle divided by 2 1000 mm = base /2 500 mm x 2000mm = 1,000,000 mm OR Area of triangle = Perpendicular height x base, divided by 2 2000 mm x 1000 mm = 2,000,000 mm divide by 2 = 1,000,000 mm Conversion to m^2 = 1,000,000mm = 1 (m^2)	2	**Correct answer scores full marks** 1 mark for showing understanding of calculating area of triangle **or** if answer not converted to m^2 (1,000,000 seen) 1 mark for correct answer in mm^2

Question			Answer	Mark	Guidance
1	(d)		**Two** from: • Council • Local residents / community • Parents /carers / childminders • Park keepers/wardens • Manufacturer • Retailer	2	Do **not** accept **children** (as given in the question as the primary user). Answers **must** be appropriate for the context in the question: **Playground equipment for a local park**.
1	(e)	(i)	**Two** from: • Questionnaires / Surveys • Interviews • Focus groups • Observations / Visits to other parks • Research into other play equipment in parks • Taking measurements of park area • Testing or using existing products yourself	2	Methods identified must be for gathering **primary** data. Accept answers specifically related to the park / equipment
1	(e)	(ii)	**One** from: • Anthropometric data • Safety standards/ BSi/ Playground equipment standards • Materials data / manufacturers information • Reviews of playground equipment • Internet research into existing equipment (pictures and information posted by others) • Magazine articles, catalogues, product literature **Accept any other appropriate secondary research for designing playground equipment.**	1	Identification **must** be **secondary** research. Answers **must** be appropriate for the context in the question: **Designing playground equipment.**

Question			Answer	Mark	Guidance	
					Content	Levels of response
1	(f)*		Discussion of the importance of considering sustainability when sourcing raw materials for products could include: • Oil is running out and is also used as fuel, so alternatives are needed such as renewable energy sources and plant or starch-based biopolymers. • drilling for oil causes environmental issues e.g. fracking, transporting oil can result in oil spills which harm wildlife • Deforestation and effects on environment – need for sustainable sources of timbers and bamboo and replanting programmes • Many metals and minerals are running out and mining and processing can cause pollution and uses energy • There can be political issues with sourcing precious metals and oil. • The processing of raw materials into usable forms uses energy and results in pollution to the atmosphere, e.g. greenhouse gases/climate change/rising global temperatures. • Transportation of raw material to be processed and the finished product to the consumer all uses energy. • How should we 'future-proof' sourcing of raw materials. • Answers could cover the ways in which designers can use the six R's and other sustainability principles and consider LCA and/or the circular economy when designing to minimise environmental impact of product **Award credit for any other appropriate response.**	**8**	Examples used could relate to any material area and may be examples of both good and bad consideration of sustainable raw materials. To achieve level 3 the candidate should cover the environmental and moral issues associated with sourcing raw materials and the impact this has on the earth/climate/future. Answers should be supported by examples for example if the playground equipment is used answers might refer to the materials used such as wood and steel. .	**Level 3 (6–8 marks)** The candidate will demonstrate thorough knowledge and understanding of the importance of sourcing sustainable raw materials for products. They will be able to undertake a thorough discussion, analysing/evaluating why sustainable raw materials are an important consideration when designing 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. **Level 2 (3-5 marks)** The candidate will demonstrate good knowledge and understanding of the importance of sourcing sustainable raw materials for products. They will be a basic attempt to discuss/evaluate why sustainable raw materials are important although they may draw on principles of sustainability. 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. Some relevant examples may be used to support the discussion Maximum of 4 marks if no evaluation is evident. **Level 1 (1–2 marks)** The candidate will show limited knowledge of environmental issues and will show limited understanding of the importance of sourcing sustainable raw materials. 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

Question			Answer	Mark	Guidance
2	(a)			5	Up to 5 marks Front view (a) • Back curved section drawn to correct radius (3cm) (1) • Accept freehand if close to overlay (start, end and mid points correct and uniform curve) Plan view (b) & (c) • Plan view 'b' outer rectangle correctly projected from Front view and directly above (1) • Two lines added 'c' for detail (1) Side view: (d) & (e) • Detail line added 'd' (1) • Side view rectangle 'e' drawn correctly to project from Front view (1)

Question			Answer	Mark	Guidance
2	(b)	(i)	Maximum number = **6** (net/developments) 1 sheet of 841 x 594mm card. Minimum size of card needed = 730mm x 528mm 365 mm x 2 = 730 mm 176 mm x 3 = 528 mm  	2	**Correct answer scores full marks** **1** mark if calculations show that a minimum card size of 730mm x 528mm is needed
2	(b)	(ii)	Number of sheets = **2084** 12,500 divided by 6* = 2,083.33333 2,083.33333 rounded to 2,084 sheets of card	2	**Correct answer scores full marks** **1** mark if answer seen is 2083 *Allow ECF from (b)(i) 12500 divided by answer from (bi) (1) Calculated correctly & rounded up (1)
2	(c)		**Two** from: • It can be cut / scored / folded easily • It is a sustainable source gives manufacturer a good name • Lightweight **so easy to carry** • Available in wide range of colours • Biodegradable so less harm to environment if thrown away • Resistant to liquids / soaks up grease so contents don't leak	2	Do **not** accept answers given in question: • recycled or printed on Do not accept 'food safe', 'non-toxic', cheap, lightweight, strong without qualification Do not accept rigid Answers **must** be appropriate for the context in the question: **Manufacturers of food packaging.**
2	(d)	(i)	Cost saving = £ **625** £0.02 x 12,500 = £250 £0.07 x 12,500 = £875 £875 - £250 = £625	2	**Correct answer scores full marks** 1 mark for showing calculation of: £0.02 x 12,500 = £250 **and** £0.07 x 12,500 = £875 1 mark if decimal in wrong place eg. £6.25

Question			Answer	Mark	Guidance
2	(d)	(ii)	Cost = £ **325** £0.02 x 12,500 = £250 10% of £250 = £25 so 30% of £250 = £75 £250 + £75 = £325	2	**Correct answer scores full marks** Allow ECF from (d)i **1** mark if 30% of cost is correctly calculated/shown

Question			Answer	Mark	Guidance
3	(a)	(i)	**Two** from: • ABS/Acrylonitrile Butadiene Styrene • Acrylic • PET/ Polyethylene Terephthalate • HDPE/ High-density polythene • PVC/ Polyvinyl Chloride • LDPE/ Low-density polythene • PS/ Polypropylene • PP/ Polystyrene • TPU / Thermoplastic polyurethane • TPE / Thermoplastic elastomer • Nylon Accept any other named **thermo polymer**	**2**	Do **not** accept thermo**setting** polymers eg. Silicone, epoxy resin Accept polythene
3	(a)	(ii)	**Two** from: • Mouldable/easy to shape able to be extruded when heated • Different colours are available or the thermo plastic can be dyed to make a specific colour • Can be transparent (few materials can be) • No adhesives needed (sticks together once cooled) • Low cost (compared to other materials) • Good strength to weight ratio • Low melting point so less heat / energy needed to use	**2**	Answers **must** be appropriate for the context in the question: **why thermos polymers are a good choice for 3D printing** Do not accept: can be re-heated / reshape/ re-used

Question			Answer	Mark	Guidance
3	(a)	(iii)	Up to **three** marks for an explanation e.g: They can offer bespoke/customised products to the consumer (1), as 3D printing can be for an individualised product, small batch run of one(1), customers will pay more for customised products (1) Mathematical modelling and FEA can reduce materials used in soles to make the trainer strong and lightweight (1) yet use less material (1) this saves money/ helps the environment (1) Customers can have feet scanned and have soles manufactured to fit precisely (1) this means that companies can respond to individual needs of customers (1) avoid waste by only producing products that have been ordered specifically (1) Companies such as Adidas and New Balance are printing trainer soles customising to different runners/ athletes needs to improve performance (1) this raises the companies' profile in sporting world (1) more consumers are interested as a result of the trainers high profile/ popularity (1)/ sales increase. Feedback from users means designer could adapt the design in CAD model quickly/ relatively easily (1) and changes implemented on the manufacturing floor immediately (1)	3	Answers **must** be appropriate for the context in the question: **benefit to a designer of using 3D printing in the design of trainers** Up to **two** identified points and one mark for an explanation of how it helps the **designer** **OR** **One** point explained well as to how it will help the designer. Do **not** accept benefits for solely improving consumer experience/use although customers and manufacturers may be referred to. **Award 1 mark for reference to accuracy, precision, consistency of products**

Question			Answer	Mark	Guidance
3	(b)		Movement sensors (1) can be used to automatically switch lights (1) on when movement is detected (1) Moisture sensor (1) can sense when an object is wet or dry and set an alarm (1)– e.g. a bath is full or a plant needs watering (1) A heat sensor/ smoke detector (1) can be used to detect heat or smoke and set of a warning alarm (1) to alert to potential fire (1) A light sensor can be used to detect when its dark (1) and switch on a night light automatically (1) to help with security (1)	3	1 mark for a sensor 1 mark for how it functions 1 mark for it related to a specific use in a product/ system Accept: ‘parking sensor’ (electromagnetic or ultrasonic sensors), ‘lane adjustment sensor’, ‘braking sensor’, ‘tyre pressure’ and other car related sensors.
3	(c)		Up to **two** marks for an explanation e.g: Can be modified or customised (1) to individual customer needs or to carry out specific functions (1) Will follow sequence of instructions to make consumers life easier /safer (1) eg. by alerting them that an alarm has been set off (1) Small sized which allows them to be used in many different products (1) eg. smart watches/monitors/glasses which allow consumers to wear technology that can improve their health/fitness (1)	2	Answer must relate to how the programmable microcontroller benefits the **consumer**. 1 mark for how the microcontroller has benefitted the consumer, 1 mark for explaining how/why. OR An identification of a product that a microcontroller is used in (1) and an explanation of how it improves the consumers experience/life (1)

Question			Answer	Mark	Guidance
3	(d)	(i)	**Two** from: • AI / Artificial intelligence • Augmented reality • Biometrics • IOT (Internet of Things) • Nano technology • Robotics • Virtual reality • Smart Alloys / SMA's • Technical textiles • Wireless charging • Phone APP controlled devices such as ring doorbell, keyless entry, lights • Phone payment for goods • Driverless cars • Drones • Lithium – ion car batteries / hybrid vehicles (see guidance)	**2**	Do **not** accept **3D printing** (as this is given in the question). Do not accept: • CAD/CAM, CNC, Laser cutting • Additive manufacture • Bio fuels Do not accept 'electric vehicles' or 'Tesla'on its own.

Question			Answer	Mark	Guidance
3	(d)	(ii)	Impact of emerging technologies on industry could include: • 3D printing - production to take place closer to the customer local/ mobile manufacturing, possibilities of 3D printing within our homes or in local centres might mean in the future we can download products, print them and avoid the need for transportation and deliveries, reducing environmental impacts of distribution processes/ 3D printing allows manufacturers to produce customised products for fraction of cost, small & large companies to offer bespoke customised designs. • Companies like Ford are exploring 3D printing to make tooling and prototypes, which can be tested just hours after their initial design, rapid prototyping and direct digital manufacturing (DDM). 3D printing to directly fabricate final products/ parts. Airbus is now using 3D printed components in its aircraft, with its latest A350 XWB containing over 1,000 3D printed parts. In the automotive sector, 3D printing is used to make parts for F1 racing cars.- 3D printed car. • AI/ Robotics used to assemble products on automated production lines/ use of lights out manufacturing facilities. Less waste, human error when mass/automated production is used, more accurate and consistent products can be made. Use of IOT to control production • VR used to assemble parts and test products/ train people to assemble before manufacture reduces waste/error (saves money) • Disruptive technologies – A Disruptive technology is an innovation that significantly alters the way that consumers, industries, or businesses operate. A disruptive technology sweeps away the systems or habits it replaces because it has attributes that are recognisably superior. • Recent disruptive technology examples include e-commerce, online news sites, ride-sharing apps, and GPS systems. • In their own times, the automobile, electricity service, and television were disruptive technologies **Award credit for any other appropriate response**	**6**	**Level 3 (5–6 marks)** The candidate will demonstrate sound understanding of emerging technologies. Thorough evaluation of the impact on the manufacturing industry supported by appropriate examples. **Level 2 (3–4 marks)** The candidate will demonstrate some understanding of emerging technologies. A basic attempt to evaluate the impact on the manufacturing industry supported by some appropriate examples. **Level 1 (1–2 marks)** The candidate will give a basic answer showing limited understanding of emerging technologies. No attempt at evaluation and any examples may not be appropriate. **Level 0 (0 marks**) No response or no response worthy of credit.

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Mark</th><th>Guidance</th></tr>
<tr><td>4</td><td>(a)</td><td>(i)</td><td>
<table>
<tr><td>Function</td><td>Component</td><td>Input/output</td></tr>
<tr><td>Allows the user to select songs/apps and play music</td><td>Switch (Click wheel or touch screen)</td><td>Input (1)</td></tr>
<tr><td>Produces sound to play music for the user</td><td>EarPods (in-ear headphones)</td><td>Output (1)</td></tr>
</table>
</td><td>2</td><td>One mark for each correct answer.</td></tr>
<tr><td>4</td><td>(a)</td><td>(ii)</td><td>• Battery / rechargeable / cell</td><td>1</td><td></td></tr>
<tr><td>4</td><td>(a)</td><td>(iii)</td><td>Two from:
• Respond to technological push/ to keep up with competition from other companies/ new technologies
• Market pull/ people want new products
• To sell more/ increase sales
• Planned obsolescence/ Parts wear out/deteriorate
• Bug fixes which prolong lifespan of product and ensure customer satisfaction
• More functions added which meet customer needs
• Keep up with / follow upcoming trends to ensure customer satisfaction</td><td>2</td><td></td></tr>
<tr><td>4</td><td>(a)</td><td>(iv)</td><td>Up to two marks for an explanation e.g.:

Systems thinking is when a product is not seen as just a product it is seen as part of a system (1) that works with a number of products often to provide a service (1)</td><td>2</td><td>Other examples such as Google – Google drive, mail, calendar etc which are all synced.

Definition of systems thinking:</td></tr>
</table>

			or Apple provide a music download service (1) to work alongside their phone/ iPod – apple music along with other products (e.g. the iPod and ear pods and iMac laptops and desktop computers) that work together (1)		The understanding of a product or component as part of larger system of other products and systems. Consideration of all the parts and components in one system or sub system.
4	**(b)**	**(i)**	**One** from: • horizontal and vertical yarns in an **under and over** format/configuration (1) or • **Warp and weft** yarns in an under and over format/configuration (1)	**1**	Description must relate to a **woven** fabric Do not accept: interlocking, interwoven, overlapped, intertwining
4	**(b)**	**(ii)**	Up to **two** marks for one benefit explained e.g. • It is tougher/stronger/longer lasting than a non-woven material (1) when stretched/worn/more suitable for body movement/wear ability (1) • Allows breathability (1) so sweat/moisture can evaporate/moisture wicking (1) • Improves comfort /(1) so can mould to shape of foot / wear for longer (1) • Flexible (1) so more comfortable to wear (1) • It enables less pieces to be used (1) to achieve strength/construction can be kept simple (1) • Different colours can be woven (1) and this improves aesthetics/appeal/fashion trends (1) • Lightweight (1) so more comfortable to run/exercise in (1) • Woven fabric can be washed /cleaned easily (1) and dries quickly(1)	**2**	Answers **must** be appropriate for the context in the question: woven fabric for **sportswear.** Award 2 marks for one benefit with explanation or two separate benefits with no explanation.

Question			Answer	Mark	Guidance
5	(a)		Up to **two marks** for describing how the working property of a material(s) in their chosen product makes it suitable for the product. **Two different** properties required. e.g.: **320gsm Cardboard** Easy to cut and score (1) making it suitable for the net (1) Can be printed on (1) the package has graphics (1) **Aluminium foil** Will not rust or corrode (1) so safe with food (1) Lightweight/ good strength to weigh ratio (1) keeps package weight down (1). **Denim** The denim twill/ weave makes the jeans durable (1) so they will be hardwearing (1). It is washable (1) so can be cleaned easily (1) **Copper / Brass** Malleable / easy to form / cast (1), rust resistant (1),attractive self-finish (1) more durable than stitching / plastic button (1) **Cast Iron** Malleable/ easy to form/cast to shape (1) into shape of base (1) Hardness (1) ability to withstand indention or scratches/ abrasion (1) Heavy and dense material (1), so the weight counterbalances the lamp. **Mild Steel** It is tough (1) and so when used in moving parts will withstand impact (1) Malleable/ easy to form to shape (1) into section for frame or shape of light shade (1) **Stainless steel** Resistant to wear & tear (1) good tensile strength (1) suitable for spring stretched (1) Will not rust/corrode (1) spring won't corrode and stop functioning (1) **PET** Has good chemical resistance and low moisture absorption (1) so suitable for packaging liquids (1). Has high strength/rigidity/hardness (1) makes it suitable for use in a bottle (1) Can be moulded into shape easily (1) low-cost material to keep unit cost low(1)	**4**	One mark for specific 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. Allow one mark if candidate uses incorrect material but gives correct working properties. Must be **working properties not general properties** Do not accept: recyclable

Question			Answer	Mark	Guidance
			HDPE has good chemical resistance and low moisture absorption (1) so suitable for lids to package liquids (1). Flexible and hardwearing (1) for lid which is gripped to open and close the bottle (1) Can be moulded into shape easily (1) low-cost material to keep unit cost low (1) **Aluminium** Will not rust or corrode (1) so safe with food (1) Good strength to weigh ratio (1) will be subject to compressive forces in use (1). Can be moulded/ cast (1) into an intricate shape with a quality surface finish (1) **Rubber** Flexible and soft (1) to not mark surface when used (1) durable and hardwearing will last when subjected to force/ impact (1) easily moulded to shape (1) and keeps unit cost low (1) **Beech** Dense material (1) strong in small sections (1) flexible and suitable for bending (1) Good strength to weight ratio (1) Material is durable and long lasting with daily use (1) **Plywood** Plywood Layering makes the material stronger (1) and suitable to hold weight of a person (1) Good strength to weight ratio (1) Uniform characteristics across a board (1) **Award credit for any other appropriate response**		

Question			Answer	Mark	Guidance
5	(b)		Candidates description should show knowledge and understanding of the stages required to source and process their chosen material into a useable form. Sourcing of raw materials and processing/converting into a useable form, stages should cover now raw materials are extracted or harvested, then go through a number of manufacturing steps until material is a useable form. Processing raw materials can involve chemical or physical processing methods, for example, smelting and converting ores into usable materials, making polymers from oil. Answers could include: **Toblerone packaging – (papers and boards)** **Cardboard**– raw wood chippings are pulped by soaking them in water and pulverising. Pulp is pressed through a series of rollers to become paper/card. 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. The recycling processes can uses same basic steps sorting, shredding, pulping, filtering, drying, pressing and rolling. **Levi denim jeans – (fibres and fabrics)** **Denim/Cotton** is farmed from the seed pod (boll) of the cotton plant and uses large volumes of water. Once picked, the cotton goes through a ginning process, to separate the fibre from the seed. Raw cotton bales are dried to remove any moisture. The cotton first goes through dryers to reduce moisture content and then through cleaning equipment. Once cotton has been baled it is sent to a mill for spinning or weaving into fabric. Denim uses twill weave of blue and white sometimes a blend is used but mostly just cotton. The blue yarns are the lengthwise or warp threads and the white yarns run across the fabric width i.e. the weft threads. Dyes, prints or special finishes are added.	**8**	**Level 3 (6-8) marks** The candidates will demonstrate an excellent understanding of the processes required to source and process their chosen material into a useable form. Their explanation will be thorough, using appropriate terminology and show a clear and logical understanding of the required stages to process the raw materials into a useable form. All stages are considered. **All stages of extraction and processing should be considered for level 3 marks to be awarded.** **Level 2 (3-5 marks)** The candidates will demonstrate some understanding of the processes required to source and process their chosen material into a useable form. Their explanation 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 process their chosen material into a useable form. Not all stages are considered. Their response will lack detail and may be little more than a list of unordered points. **Level 0 (0 marks)**

			Anglepoise lamp (design engineering) **Stainless steel** made from iron ore. Ores are dug out of the ground by mining, then metals are separated. 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. **Coca-Cola bottle (polymers)** **PET 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. **Juicy Salif citrus Squeezer (metals)** **Aluminium**. Bauxite is used as the main raw material in aluminium. It is a clay mineral found in areas such as Australia. It is mined from 1-2 metres underground and then passes through a grinder, the ground bauxite is pumped into large pressure tanks with a caustic soda solution, and a steam is applied. The caustic soda reacts with the aluminium compounds in the bauxite material to produce a solution of sodium aluminate (slurry). The unwanted minerals sink, and the alumina remains and is filtered and aluminium hydroxide is added to cause precipitation, heat is used to calcify then the crystals are smelted to make pure aluminium. Pure aluminium then needs to be alloyed to increase its strength. **Thonet bistro chair (timbers)** **Beech**. Tree is cut down/ felled, it is cut roughly into boards, planks or veneer (conversion) and debarked. They are then ‘re-sawn’ with more precise cutting and finishing, such as planing and further machining. 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.		No response or no response worthy of credit.

Question			Answer	Mark	Guidance
5	(c)	(i)	Up to **two** marks e.g.: **Toblerone packaging – (papers and boards)** Die cutting (1) – suitable as it cuts and scores identical/accurate card products (1) **Levi denim jeans – (fibres and fabrics)** **Industrial** sewing machine and overlocker to join the denim (1) – suitable for heavy tough fabrics like denim (1) Cutting pattern pieces using a band saw (1) cuts though several layers at once to speed up the production process.(1) Bio-stoning / stone washing / enzyme washing (1) to fade and soften the denim (1) **Anglepoise lamp – (design engineering)** Cast (1) repeatability - suitable for moulding identical pieces that are solid (1) Extruded (1) the frame uses a section that is shaped and made by forming a continuous cross section that is cut to length (1) **Coca-Cola bottle – (polymers)** Blow moulded (1) repeatability - can create a hollow shape identical every time (1) **Juicy Salif citrus squeezer – (metals)** Die casting (1)) repeatability - produces intricate/ complex moulded shapes (1) **Thonet bistro chair – (timbers)** Steam bent (1) use of former ensures repeatability - for high level batch production of bent wood shape (1) **Accept any other suitable commercial processes used in the manufacture of the product**	**2**	One mark for naming a suitable process for **commercial** production. Process must be in the **manufacture of the product** NOT the processing of the raw material One mark for relating process suitability to product shape, material strength etc.

Question			Answer	Mark	Guidance	
					Content	Levels of response
5	(c)	(ii)	**1:Toblerone Packaging- (papers and boards)** Die cut and scored, flexography printed. **2: Levi Jeans - (fibres and fabrics)** Industrial overlocked and double seams, riveted. **3: Anglepoise lamp- (design engineering)** Extruded metal for frame, cast iron base. **4: Coca-Cola bottle- (polymers)** Blow moulded bottle and injection moulded lid. **5: Juicy Salif citrus squeezer- (metals)** Die cast. **Product 6: Thonet bistro chair- (timbers)** Steam bent, drilled. Allow step-by-step plans or description of one or two production methods that may be used to commercially manufacture the chosen product. Candidates can use sketches and notes to support their answer, it should follow an appropriate order and cover the following: • Materials, tools, moulds and components that would be used • Processes, techniques or skills • Any digital technology used as appropriate. e.g.:	**9**	Candidates can refer to manual, machine or CAD/CAM processes, but they must be appropriate for commercial manufacture. If a response only describes a candidate's own workshop experiences and knowledge of tools and processes rather than a commercial level of manufacture then it should not be awarded marks higher than a Level 1. 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	**Level 3 (7-9 marks)** The candidate demonstrates they have fully analysed the information given on the Insert recognising all details required for making their 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). Specific process(es) 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

			• 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 – including how to ensure accuracy. e.g. all tools required to fulfil the processes and techniques being used. **Award credit for any other appropriate response/commercial processes**		supporting annotation.	adequate understanding of the commercial manufacturing techniques and processes required to make their chosen product. They will demonstrate a good knowledge of how to work with tools that may not always be specific and digital technology may be used (if appropriate). Specific process(es) will have been identified that 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 and/or planning is limited or not evident showing little knowledge of the commercial manufacturing processes. The candidate's response will lack detail and demonstrate a limited understanding of the manufacturing techniques and/or processes required to make their 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 and techniques may not be fully appropriate or identified. **Level 0 (0 marks)** No response or no response worthy of credit.

Specific techniques	Processes, techniques or skills
Product 1: Toblerone packaging- (papers and boards) Die cut and scored, flexography	Creating a template or die. Preparing nets on a computer program, tessellated to avoid wastage. Die cutting – a die is lowered onto the cardboard and pressed to cut out the shape. Folding along score lines and tabs, creasing tool, blunt tool. Flexography for applying images, cylinders rotate to print onto the card - CMYK color system.
Product 2: Levi Jean- (fibres and fabrics) Industrial overlocked and double seams, riveted	Pattern is cut out for jeans shape, pocket and belt loops (digital design, lay planning, band saw). Layers of fabric are held together and overlocked, a folded seam edge to reinforce, and straight stitch machine sewn with industrial sewing machine. Belt loops, buttonhole, fly and zip sewn using industrial sewing machine. Rivets applied with a rivet gun or tool.
Product 3: Anglepoise lamp- (design engineering) Extruded metal for frame, cast iron base.	Molten metal is fed into a die using a plunger and goose neck. The molten metal is pushed into using gravity the die, the process is continuous, and a uniform section is pushed out and then cut to length. The desired lengths are drilled and assembled. The shade could be stamped, and press formed. Sand Casting a pattern is used to create an empty cavity of the shape of the part required in sand, which is enclosed in a moulding box (cope and drag). Sand is rammed around the shape and once complete the pattern is removed and runners and riser channels are cut. Molten metal is then poured into the mould cavity in the sand and when cooled the sand is broken away to reveal the part required. Die casting could be used see metals (Product 5) for process.
Product 4: Coca-Cola bottle- (polymers) Blow moulded bottle and injection moulded lid.	Polymer granules/pellets are poured into the machine through a hopper. The granules are heated and melted to liquid form as they are carried along the barrel by a screw thread. The piston is drawn back then released so the liquid plastic is pushed into the die to form parison/ pre mould, this parison is then placed into another mould which is heated, and air blown in so that plastic takes the shape of the heated mould cavity - extrusion blow moulding Injection moulded – Polymer granules/pellets are poured into the machine through a hopper. The granules are heated and melted to liquid form as they are carried along the barrel by a screw thread. The piston is drawn back then released so the liquid plastic is pushed into the die to bottle lid. The Die is made from steel.
Product 5: Juicy Salif Juicer- (metals) Die cast	The two sections of the mould / die are mounted securely in a machine and are arranged so that one is stationary (fixed die half) while the other is moveable. To begin the casting cycle, the two die halves are clamped tightly together by the die casting machine. Hydraulics are used to achieve the high pressures molten metal is injected into the die cavity where it solidifies quickly. Dies are cooled by water circulating through channels / holes in the dies, The die halves are drawn apart and the casting is ejected. Sprues are removed. The Die is made from steel. Gravity die casting might also be used with a plunger and goose neck Accept lost wax casting – a wax mould shape is produced, and this is then placed in a ceramic slurry – the ceramic hardens – molten metal is poured in and the wax melts leaving the metal shape the ceramic is broken off.
Product 6: Thonet bistro chair - (timbers) Steam bent, drilled.	Steam bending – timber is placed in a sealed box and steamed; timber absorbs hot moisture and becomes softer. Formers used to hold the timber in place whilst it dries it then takes shape of mould once unclamped. Jig and drilling machine (pillar) used to drill holes for legs/screws.

Question			Answer	Mark	Guidance
6	(a)		Up to **two** marks for each reason explained. **Two** required. E.g.: **Toblerone packaging – (papers and boards)** • The packaging and chocolate shape – (triangles and the Matterhorn) is memorable/ recognisable (1) and has strong branding. (1) • Different varieties dark, white and milk chocolate available (1) to suit different tastes (1) • The company has a good name for quality (1) they are an established trusted brand (1). **Levi denim jeans – (fibres and fabrics)** • Hardwearing and durable / double stitched (1) they are an established trusted brand (1). • Different washes and styles are regularly released (1) to suit different tastes/ fashion styles. (1) • The red tag is recognisable (1) and has strong branding. (1). • 501 style/fit (1) comfortable yet stylish- copied by other brands (1) **Anglepoise lamp – (design engineering)** • Its functionality and simple design style (1) – form follows function.(1) • Its versatile design means it can be used in different places (1) it comes in a range of colours to suit different environments (1). • Its durable and long lasting (1). The design and brand is established and trusted (1). **Coca-Cola bottle – (polymers)** • Popular string branding (1) with recognisable bottle shape/ design (1) • Can be refilled and lid allows bottle to be closed tightly and carried around, (1) consumed later helps its usability.(1) • Different varieties coke zero, diet coke etc (1) suit different tastes (1) **Juicy Salif citrus squeezer – (metals)**	**4**	Accept **any valid reason** related to: • Company values and trusted brand/ well known designer • Customer perception of quality • Different variations of design materials, colours etc • The influence of fashion, trends, taste and/or style • The influence of marketing and branding • The impact on society and culture • The impact on usability • The impact on the environment

			• Quirky design/ well known designer/ brand makes the product a talking point (1) this is trendy and fashionable (1) • Simplistic design style in terms of materials and shape (1) yet functional and useful (1) • Available in different finishes such as gold (limited editions) (1) to suit different styles and markets (1) • Its simple shape/ style and neutral colour (1) mean it fits into any kitchen environment. (1) **Thonet bistro chair – (timbers)** • Durable long lasting. (1) The design and brand is established and trusted (1). • Can be dismantled easily for storage/ parts easily replaced (1) improves usability. • Simple recognisable design style (1) linked with café culture/ trends/ Parisian style (1) • Different varieties/ variations (1) e.g. chairs with arms suit different environments and tastes/ styles (1) **Award credit for any other appropriate response**		

Question			Answer	Mark	Guidance	
					Content	Levels of response
6	(b)*		Explanation of how the aesthetics of the candidates chosen product and other iconic products they are familiar with have influenced design thinking and product design could include: • form • texture • use of colour, harmony, contrast and impact • symmetry and asymmetry • proportion • form follows function Examples include their iconic products in the insert booklet: • Toblerone packaging • Levi denim jeans • Anglepoise lamp • Coca-Cola bottle • Juicy Salif citrus squeezer • Thonet bistro chair And any other iconic products such as: Michael Graves kettle and Alessi products. Burberry check, Vespa scooters, biro pens, streamlining in cars and ships/boats. Form follows function in Apple products and the influence of Braun and Dieter Rams, less is more approach, use of the golden ratio in screen design and logos, packaging graphics. Asymmetry used in clothing and furniture for impact, colours working together in harmony or	8	Candidates should be drawing on examples to support their answer. Examples of products can be from any material area.	**Level 3 (6–8 marks)** The candidate will demonstrate thorough knowledge and understanding of aesthetics and its use and impact in the design of products and design thinking. They will be able to present a detailed explanation of the influence of aesthetics, positively and negatively, on design thinking and product design. Candidates will be drawing on their wider understanding/experience of the whole subject. They will be able to present a thorough explanation **using their product and other iconic products to support their answer.** 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 good knowledge and understanding of aesthetics and its use and impact in the design of products and design thinking. Candidates will be drawing on their wider understanding/experience of the whole subject. They will be able to present a sound explanation **using products to support their answer.** There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence. Some relevant examples are used to support their answer. Maximum of 4 marks if **no reference made to their product or other iconic products.** **Level 1 (1–2 marks)**

			contrast, fabric and material textures, such as Issey Miyake folds in fabric. The Mini Car monoque structure, Eames furniture using bent plywood and the Bauhaus form follows function principles and designers such as Marcel Breuer. James Dyson influence on other vacuum cleaners and products in terms of functionality and use of colours to help usability and ergonomics. **Award credit for any other appropriate response**			The candidate will demonstrate limited knowledge/understanding of aesthetics and its use and impact in the design of products and design thinking. The information is basic and communicated in an unstructured way. The information is supported by limited/no evidence and the relationship to the evidence may/is not be clear. **Level 0 (0 marks)** No response or no response worthy of credit

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