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# GCSE DESIGN AND TECHNOLOGY 8552/W

Unit 1    Written Paper

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**Mark scheme**

June 2019

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Version: 1.0 Final

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from [aqa.org.uk](http://aqa.org.uk)

## Level of response marking instructions

Level of response mark schemes are broken down into levels, each of which has a descriptor. The descriptor for the level shows the average performance for the level. There are marks in each level.

Before you apply the mark scheme to a student's answer read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

### Step 1 Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

When assigning a level you should look at the overall quality of the answer and not look to pick holes in small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level and then use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 3 with a small amount of level 4 material it would be placed in level 3 but be awarded a mark near the top of the level because of the level 4 content.

### Step 2 Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the Indicative content to reach the highest level of the mark scheme.

An answer which contains nothing of relevance to the question must be awarded no marks.

Qu	Part	Marking Guidance	Total marks	AO
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**SECTION A**

1		<b>A</b> a business that is owned and managed by its workers.	1	AO4
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2		<b>B</b> Hydro-electrical	1	AO4
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3		<b>D</b> Repairable components	1	AO4
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4		<b>D</b> Silk	1	AO4
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5		<b>C</b> Foil lined board	1	AO4
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6		<b>A</b> Light sensor	1	AO4
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7		<b>D</b> Pine	1	AO4
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8		<b>D</b> Rotary to reciprocating	1	AO4
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9		<b>B</b> Using fossil fuels	1	AO4
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10		<b>B</b> 62 370 mm <sup>2</sup>	1	AO4
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11		<table border="1"> <thead> <tr> <th></th> <th><b>Alkaline batteries</b></th> <th><b>Re-chargeable batteries</b></th> </tr> </thead> <tbody> <tr> <td><b>Cost of batteries and charger if required</b></td> <td>£2.45 for 4 batteries</td> <td>£17.00 for 5 batteries and a charger</td> </tr> <tr> <td><b>Cost per re-charge of 5 batteries</b></td> <td>£0</td> <td>£0.03 for 5 batteries to be re-charged</td> </tr> <tr> <td><b>Cost to customer after 5 battery changes or 5 re-charges</b></td> <td>£ 2.45 x 5 = £12.25</td> <td>£17.00 plus £0.03 x 5 = £17.15</td> </tr> </tbody> </table>		<b>Alkaline batteries</b>	<b>Re-chargeable batteries</b>	<b>Cost of batteries and charger if required</b>	£2.45 for 4 batteries	£17.00 for 5 batteries and a charger	<b>Cost per re-charge of 5 batteries</b>	£0	£0.03 for 5 batteries to be re-charged	<b>Cost to customer after 5 battery changes or 5 re-charges</b>	£ 2.45 x 5 = £12.25	£17.00 plus £0.03 x 5 = £17.15	2	AO4
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12		<p>1 mark for each simple correct point of explanation or 2 marks maximum for one point explained in detail/clarified with an example.</p> <p><b>Indicative content:</b></p> <ul style="list-style-type: none"> <li>• arranged as a mat (non woven) = 1</li> <li>• arranged in layers = 1</li> <li>• woven = 1</li> <li>• spun into ropes = 1</li> <li>• can be treated with chemicals = 1</li>   <li>• Woven for strength as a net/mat = 2</li> <li>• Woven to create a net like structure resistant to penetration, e.g. knife attack = 2</li> <li>• Chemical treatment to make fibres more flexible, e.g. easier to move wearing them as clothing</li> <li>• Woven for strength as a net to create interlocking structure e.g. to resist bullets in body armour = 2</li> </ul> <p>NB STRONG MUST BE QUALIFIED FOR CREDIT</p> <p>Accept all other valid responses</p>	2	AO4
13		<p>1 mark for each property correctly identified.</p> <p><b>Indicative content:</b></p> <p>Look for reference to MDF, plywood and chipboard as per specification <b>NOT</b> cardboard</p> <ul style="list-style-type: none"> <li>• Available in sheets of a consistent quality</li> <li>• Good sound proofing if qualified, e.g. board thickness and application</li> <li>• Large/standard size of boards means several parts can be 'nested' of one sheet and cut out</li> <li>• Excellent surface finish (to accept a spray paint finish or a laminate)</li> <li>• Consistent board thickness available</li> <li>• Free from natural defects, e.g. knots</li> <li>• Free from inconsistencies in physical characteristics, e.g. grain direction</li> <li>• Stability e.g. no warping or twisting like natural wood</li> <li>• Insulation e.g. can prevent transfer of electrical current and use in engineered timber for buildings (glulam) requires less energy to heat and cool.</li> <li>• Good strength to weight ratio</li> </ul>	2	AO4

		<ul style="list-style-type: none"><li>• <b>Not shaped and cut</b></li><li>• <b>Not easy to cut</b></li><li>• <b>Not easy to recycle</b></li></ul> Accept all other valid responses		
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14		<p>1 mark for each point of explanation appropriate to improve efficiency.</p> <p>One point explained and clarified in more detail, e.g. with example is worth 2 marks</p> <p><b>Indicative content:</b></p> <ul style="list-style-type: none"> <li>• No need for factory space to be used to store materials = 1</li> <li>• More factory space can be allocated to production/output = 1</li> <li>• Materials/components do not become old/ out of date = 1</li> <li>• Money is not invested in unused stock = 1</li> <li>• More factory space can be allocated to production/output = 1</li> <li>• Improved manufacturing competitiveness through reduced time waste and resources i.e. no ordering resources and needed or moving and storing of unused resources = 2</li> <li>• No need for large storage facilities so reducing construction/maintenance costs = 2</li> <li>• Materials/ components do not become old/ out of date so reducing costs and wastage = 2</li> </ul> <p><b>NB No mark for repeating 'just in time' or 'improve efficiency' as they are in the question stem.</b></p> <p>Accept all other valid responses</p>	4	AO4

Qu	Part	Marking Guidance	Total marks	AO
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**SECTION B**

15		<p>1 mark for each correctly named force up to a maximum of 3 marks</p> <p><b>Indicative content:</b></p> <p><b>Legs:</b> bending <b>or</b> compression</p> <p><b>Seat:</b> compression</p> <p><b>Straps:</b> tension</p>	3	AO4
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16		<table border="1"> <tr> <td><b>5-6 marks</b></td> <td>A detailed description making several correct points for selected addition process using notes <b>and</b> sketches. Specific correct and appropriate named tools and equipment to further clarify response.</td> </tr> <tr> <td><b>3-4 marks</b></td> <td>A description with points showing some understanding of the selected addition process using notes <b>and</b> sketches. Basic reference made to some tools and equipment to clarify understanding.</td> </tr> <tr> <td><b>1-2 marks</b></td> <td>Simple notes <b>or</b> sketch showing limited understanding of selected addition process.</td> </tr> <tr> <td><b>0 marks</b></td> <td>Nothing worthy of credit</td> </tr> </table>	<b>5-6 marks</b>	A detailed description making several correct points for selected addition process using notes <b>and</b> sketches. Specific correct and appropriate named tools and equipment to further clarify response.	<b>3-4 marks</b>	A description with points showing some understanding of the selected addition process using notes <b>and</b> sketches. Basic reference made to some tools and equipment to clarify understanding.	<b>1-2 marks</b>	Simple notes <b>or</b> sketch showing limited understanding of selected addition process.	<b>0 marks</b>	Nothing worthy of credit	6	AO4
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<p>AN EXCELLENT RESPONSE WITH NO SKETCHES- MAX 5 MARKS FOR RUBRIC INFRINGEMENT.</p>												
<p><b>Indicative content:</b></p>												
<p><b>Lamination</b> Expect reference to lamination of paper, plastics, textiles or wood. Looking for reference to use in order to improve strength, stability, flexibility and possibly aesthetics,  Possible consideration of laminating machine with polymer pouches to stiffen and water proof card. Gluing layers of veneer under pressure (clamps) with adhesive using formers. Fabric interfacing to stiffen collars and caps on clothing.</p>												
<p><b>Printing/3D printing</b> Expect reference to application on paper, card and textiles. <b>Do not forget developing technologies using PLA polymer with 3D printing machines to manufacture parts/components etc.</b> Specific additional printing techniques include screen printing,</p>												



		<p>digital printing, offset lithography printing, flexography, dye sublimation printing, direct printing, mordant printing, discharge printing and resist printing e.g. batik.</p> <p><b>Sewing</b> Expect reference to hand or machine. Candidates may share understanding of specific sewing techniques making a seam or adding decorative stitching/embroidery e.g. running, back, chain or blanket stitching or machine stitching like zig zag or overlocking stitch.</p> <p><b>Soldering</b> Expect reference to use in electronics, hard (brazing) soldering and soft soldering. Soldering irons e.g. electronic component soldering or commercial electronic soldering like wave or flow soldering. Soft soldering using a gas torch used in for example by a silversmith may be considered. Use of flux to allow solder to flow.</p> <p><b>Welding</b> Expect reference to welding metals or polymers. Metals are welded using gas e.g. oxyacetylene using a very hot flame or MIG and TIG welding using a large electrical current to create heat and fuse metals together. Polymers can be fused using either heat or chemicals. Chemical welding e.g. Tensol and solvent cement are common in school environments. Heat welding involves using a hot air gun and polymer filler rod of a range of thermoforming plastics e.g. HDPE.</p> <p>Accept all other valid responses</p>		
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Qu	Part	Marking Guidance	Total marks	AO
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17		<p><b>Indicative content:</b></p> <p><b>1 mark for a named process:</b></p> <ul style="list-style-type: none"> <li>• Die cutting</li> <li>• Perforation &amp; punching</li> <li>• Turning</li> <li>• Sawing</li> <li>• Milling/Routing</li> <li>• Drilling</li> <li>• Cutting - including laser cutting</li> <li>• Shearing.</li> <li>• Abrasive removal e.g. sanding, filing</li> </ul> <p>NB RECYCLING AND WASTE MANAGEMENT IS INCORRECT</p> <p><b>2 marks for describing correct situation of use:</b></p>	3	AO4
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- 1 mark for a simple descriptive point
- 2 marks for a detailed response with two credit worthy points made.

PROCESS	DESCRIPTION OF A SITUATION OF USE
Laser cutting	Information output from sources like 2D design can instruct laser to cut precisely, avoiding human error, repetitive design usually working with acrylic, plywood and card. Possible reference to setting up laser , x and y coordinates, focusing, cutting speed, power settings and extraction.
Die cutting	Used to remove a net or multiple nets from a piece of card in one operation. Process involves using knives, creasing bars and perforation blades. Used in the production of card packaging.
Perforation & punching	Perforating is where small localised areas of material are removed (paper, card & corriflute) to weaken the material to allow a controlled tear to take place, eg tissue box opening. Punching uses a die to ‘punch’ out a hole or shape of material to form a hole or an opening. Takes place on sheet material.
Turning	Involves using either a wood lathe or a metal work lathe to remove portions of material from a rotating work piece to produce a concentric profile, eg stair case spindles, metal cylinders and wooden bowls.
Sawing	Sawing takes place using one of a range of: Hand saws appropriate to a specific material or to cut straight or curved cuts, eg hacksaw (metal) dovetail saw (wood) coping saw (curved cuts in wood) Machine saws, eg band saw, fret saw and circular saw for removal of material more rapidly to cut out several or possible larger parts from a chosen material.
Milling/CNC milling	Vertical milling (common in school) and horizontal milling. Vertical milling allows slots as well as holes to be cut in materials like aluminium with ease. Horizontal milling allows large flat surfaces to be machined removing surface defects from such processes as casting.
Drilling	Production of a hole either through or blind using a twist drill or similar. Process can be complete using a hand drill, cordless drill, electric drill or pillar drill.
Cutting	Rotary cutters can be used to cut multiple layers of fabric with accurate straight or curved lines. Seam ripper has a sharp internal blade between two prongs and is used to unpick

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<p><b>Accept any other appropriate named process to remove waste material and supporting example if provided.</b></p>									

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18	1	<p>1 mark for each explanation point up to a maximum of 2 marks.</p> <p><b>This question is about explaining QC</b></p> <p><b>Indicative content:</b></p> <ul style="list-style-type: none"> <li>• Check or test = 1</li> <li>• Make sure a product meets a specific standard = 1</li> <li>• To ensure a manufactured product meets agreed specification criteria = 1</li> <li>• Guarantees the accuracy of a part or component = 1</li> <li>• Manufactured to an agreed tolerance = 1</li> <li>• Fit for purpose</li> <li>• Suitable/good enough for selling =1</li> </ul> <p>NB NOT TO PREVENT MISTAKES/STOP MISTAKES FROM HAPPENING</p> <p>Accept all other valid responses</p>	2	AO4
18	2	<p>1 mark for a simple point with a second mark for a well explained point.</p> <p><b>Looking for a specific method described. This is not a repeat of Qu18.1</b></p> <p><b>Indicative content:</b></p> <p><b>1 mark responses:</b></p> <ul style="list-style-type: none"> <li>• Visual check/test</li> <li>• Use a ruler</li> <li>• Use of a multimeter</li> <li>• Use a jig/fixture or template</li> <li>• Use of a go/no go jig</li> <li>• Testing against a specification</li> <li>• Check seam strength</li> <li>• Check seams are neatened</li> <li>• Check within tolerances</li> <li>• Testing product to see if it works</li> </ul> <p><b>2 mark responses:</b></p> <ul style="list-style-type: none"> <li>• Dimensional accuracy, e.g. use of micrometer, Vernier calipers</li> <li>• Use of jigs and fixtures, e.g. go/no go jigs and depth stops</li> <li>• Registration mark e.g. CMYB</li> </ul>	2	AO4

		<ul style="list-style-type: none"> <li>• Alignment of printing plates, hinges, catches, other interlocking parts, e.g. cross lines</li> <li>• Material quality e.g. surface inspections for defects</li> <li>• Electrical continuity, e.g. visual inspection of PCB tracks, use of multimeter</li> <li>• Safety e.g. loose parts, sharp edges</li> <li>• Flammability e.g. textiles</li> <li>• Check zips and fastenings are inserted correctly and work</li> </ul> <p>Accept all other valid responses</p>		
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19	1	<p>One mark for a correctly named specific source or origin.</p> <p><b>Indicative content:</b></p> <table border="1"> <thead> <tr> <th>Material</th> <th>Source or Origin</th> </tr> </thead> <tbody> <tr> <td>Metal based materials</td> <td>Rocks or Ore</td> </tr> <tr> <td>Paper and boards</td> <td>Trees, forests, woods and plant fibres</td> </tr> <tr> <td>Polymers</td> <td>Crude oil and plants e.g. sugar cane (biopolymers)</td> </tr> <tr> <td>Textile based materials</td> <td>Natural fibres – e.g. plant, animal or mineral source</td> </tr> <tr> <td>Timber based materials</td> <td>Trees, forests or woods</td> </tr> <tr> <td></td> <td></td> </tr> </tbody> </table> <p>Accept all reasonable responses</p>	Material	Source or Origin	Metal based materials	Rocks or Ore	Paper and boards	Trees, forests, woods and plant fibres	Polymers	Crude oil and plants e.g. sugar cane (biopolymers)	Textile based materials	Natural fibres – e.g. plant, animal or mineral source	Timber based materials	Trees, forests or woods			1	
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19	2	<p>One mark for a correctly named process appropriate to the material category.</p> <p><b>Indicative content:</b></p> <p>See table for question 19.3</p>	1															
19	3	<p>A description of the named process and how it is used to refine the chosen raw material area into workable form.</p> <p><b>NB Maximum of 2 marks if process does not relate to 19.2</b></p> <table border="1"> <tbody> <tr> <td><b>3-4 marks</b></td> <td>Well described description of a suitable process using notes and or sketches to clarify understanding.</td> </tr> <tr> <td><b>1-2 marks</b></td> <td>One or two brief descriptive points with possibly a simple sketch or image.</td> </tr> <tr> <td><b>0 marks</b></td> <td>No attempt or nothing worthy of credit.</td> </tr> </tbody> </table> <p><b>Indicative content:</b></p> <table border="1"> <thead> <tr> <th>Material area</th> <th>Source or origin</th> <th>Name a process used to convert your chosen material category into a workable form</th> <th>Describe how your named process converts your chosen material category into a workable form</th> </tr> </thead> <tbody> <tr> <td>Paper &amp;</td> <td>Trees</td> <td>Debarking</td> <td><b>Debarking</b> – removal of</td> </tr> </tbody> </table>	<b>3-4 marks</b>	Well described description of a suitable process using notes and or sketches to clarify understanding.	<b>1-2 marks</b>	One or two brief descriptive points with possibly a simple sketch or image.	<b>0 marks</b>	No attempt or nothing worthy of credit.	Material area	Source or origin	Name a process used to convert your chosen material category into a workable form	Describe how your named process converts your chosen material category into a workable form	Paper &	Trees	Debarking	<b>Debarking</b> – removal of	4	AO4
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		board and plants	Chipping/ shredding Pulping Sizing	<p>outer layers of bark and branches before chipping to make pulp.</p> <p><b>Chipping/shredding</b> – logs are converted into chips to make more manageable smaller pieces of wood which are easier to treat with chemicals before pulping.</p> <p><b>Pulping</b> – a mechanical/shredding process involving cooking wood chips in chemicals in large tanks to soften wood fibres and make a pulp.</p> <p><b>Sizing</b> – a finishing process where the wood pulp is beaten with chemicals and other additives. Sizing stops the paper from being absorbent so it can be printed on.</p>		
		Timber based materials	Felling or Debarking Conversion & sawing Seasoning	<p><b>Felling</b> – extracting living trees from forests,</p> <p><b>Debarking</b> -removal of bark, branches and creation of logs</p> <p><b>Conversion &amp; sawing</b> – Conversion of logs into planks (rough sawn) to make them more manageable and easier to handle.</p> <p><b>Seasoning</b> – reduction of the moisture content in timber to make it less prone to shrinkage and movement. Can be naturally or kiln dried</p>		
		Metal based materials	Mining Smelting	<p><b>Mining</b> – extraction of rocks from the ground (ore) containing naturally occurring metal elements.</p> <p><b>Smelting</b> – heating of metal in ore form at high temperatures in a furnace to extract metal from the rock. The separation process involves the removal of</p>		

				impurities and this is called slag				
		Polymers	Ground/earth's crust	Fractional distillation Refining/ cracking	<p><b>FD</b> – conversion of crude oil into its more usable elements e.g. diesel and petrol.</p> <p><b>Refining/cracking</b> – conversion of long chain hydrocarbons into more usable ones e.g. petrol. Heat and catalysts are used to facilitate this process</p>			
		Textile based materials	Plants and animals	Carding /combing Spinning Felting/ bonding/ needle bonding	<p><b>Carding</b> – using staple (short) Fibres they are combed to make sure they all lie in the same direction before twisting to form a yarn.</p> <p><b>Spinning</b> – where fibres are spun or twisted into a yarn. These can be filament fibres (smooth yarn) or staple fibres (hairy/fluffy yarns).</p> <p><b>Felting/bonding</b> – laying the fibres randomly in a web, moisture and agitation to mat fibres together</p>			
		Accept all other valid responses						



Qu	Part	Marking Guidance	Total marks	AO										
20		<table border="1" data-bbox="435 371 1201 1384"> <tr> <td data-bbox="435 371 608 640"><b>7-8 marks</b></td> <td data-bbox="608 371 1201 640">A fully coherent analysis and detailed evaluation of a wide range of ecological issues are considered by consumers before purchasing products. Relevant examples given. Response is well structured, with excellent use of subject terminology to justify the arguments being made.</td> </tr> <tr> <td data-bbox="435 640 608 943"><b>5-6 marks</b></td> <td data-bbox="608 640 1201 943">A logical analysis of ecological issues are considered with some evaluation by consumers before purchasing products. Evidence of examples given may not always be relevant. Response has structure. Expect an imbalance in consideration of each point. Good use of subject terminology to justify arguments being made.</td> </tr> <tr> <td data-bbox="435 943 608 1144"><b>3-4 marks</b></td> <td data-bbox="608 943 1201 1144">Some analysis of ecological issues and may contain some simple evaluation on how it might be considered by a consumer before making a purchase. Limited use of subject terminology to justify arguments being made.</td> </tr> <tr> <td data-bbox="435 1144 608 1346"><b>1-2 marks</b></td> <td data-bbox="608 1144 1201 1346">One or two brief points of basic analysis considering ecological issues. Response is likely to explain named ecological issues in general detail, but fail to link use by consumers in decision making process before a purchase.</td> </tr> <tr> <td data-bbox="435 1346 608 1384"><b>0 marks</b></td> <td data-bbox="608 1346 1201 1384">No attempt or nothing worthy of credit.</td> </tr> </table> <p data-bbox="304 1420 568 1451"><b>Indicative content:</b></p> <p data-bbox="304 1487 1139 1554">The question is looking for responses giving ecological issues a consumer might consider in the purchase of products.</p> <p data-bbox="304 1588 1163 1655">A DESCRIPTIVE LIST OF POINTS WITH NO EVALUATION IS 4 MARKS MAX.</p> <p data-bbox="304 1688 1050 1720">Expect responses to consider any of the following topics:</p> <p data-bbox="304 1753 632 1785"><b>Raw material sourcing:</b></p> <ul data-bbox="352 1794 1195 2049" style="list-style-type: none"> <li>• Deforestation, e.g. damage to the rainforests and increases in CO<sub>2</sub></li> <li>• Habitat/ ecosystem destruction, e.g. Great Barrier Reef</li> <li>• Mining, e.g. metal ores</li> <li>• Drilling, e.g. oil production</li> <li>• Farming</li> <li>• Consumers may choose sustainable fibres such as organic</li> </ul>	<b>7-8 marks</b>	A fully coherent analysis and detailed evaluation of a wide range of ecological issues are considered by consumers before purchasing products. Relevant examples given. Response is well structured, with excellent use of subject terminology to justify the arguments being made.	<b>5-6 marks</b>	A logical analysis of ecological issues are considered with some evaluation by consumers before purchasing products. Evidence of examples given may not always be relevant. Response has structure. Expect an imbalance in consideration of each point. Good use of subject terminology to justify arguments being made.	<b>3-4 marks</b>	Some analysis of ecological issues and may contain some simple evaluation on how it might be considered by a consumer before making a purchase. Limited use of subject terminology to justify arguments being made.	<b>1-2 marks</b>	One or two brief points of basic analysis considering ecological issues. Response is likely to explain named ecological issues in general detail, but fail to link use by consumers in decision making process before a purchase.	<b>0 marks</b>	No attempt or nothing worthy of credit.	8	AO3
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<b>0 marks</b>	No attempt or nothing worthy of credit.													

	<p>cotton as produced without pesticides/insecticides or PET polyester as recycled plastic bottles and finite oil is not used.</p> <p><b>Transportation:</b></p> <ul style="list-style-type: none"> <li>• Mileage of product from raw material source, manufacture, distribution, user location and final disposal</li> <li>• Carbon footprint – carbon produced during the manufacture and use of products</li> </ul> <p><b>The six Rs:</b> (in relation to their impact on the ecology of the planet)</p> <ul style="list-style-type: none"> <li>• RECYCLE e.g. break down a part or materials and separate into same materials and use to make a new part/product</li> <li>• REDUCE e.g. use less energy, materials and resources to manufacture a product or part</li> <li>• REUSE e.g. repurpose/upcycle and use for something new</li> <li>• RETHINK e.g. is there a better way of manufacturing /using materials to have less of an impact on the planet etc.</li> <li>• REFUSE e.g. customers choose to not buy products that are unsustainable to make/consume</li> <li>• REPAIR e.g. replace a part or component when defective to extend life and delay throwing away/end of life disposal.</li> </ul> <p><b>Pollution:</b></p> <ul style="list-style-type: none"> <li>• Pollution of the oceans e.g. polymers in the ocean</li> <li>• Atmospheric pollution including acid rain</li> <li>• Consumers may choose unbleached/undyed cotton as no bleach or harmful dyes used</li> </ul>		
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Qu	Part	Marking Guidance	Total marks	AO
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**SECTION C**

21	1	<p>Responses may consider both positive and negative points – both equally valid.</p> <table border="1" data-bbox="306 539 1131 779"> <tbody> <tr> <td data-bbox="306 539 475 640"><b>3-4 marks</b></td> <td data-bbox="475 539 1131 640">Well described and justified analysis containing full evaluation, drawing conclusions having considered a range of factors</td> </tr> <tr> <td data-bbox="306 640 475 741"><b>1-2 marks</b></td> <td data-bbox="475 640 1131 741">Brief points mentioned but not fully explained. Analysis present but limited evaluation/conclusions drawn.</td> </tr> <tr> <td data-bbox="306 741 475 779"><b>0 marks</b></td> <td data-bbox="475 741 1131 779">No attempt or nothing worthy of credit</td> </tr> </tbody> </table> <p><b>Indicative content:</b></p> <ul style="list-style-type: none"> <li>• Bright colours are engaging encouraging children to interact</li> <li>• The house feature may promote child interaction</li> <li>• Lots of different things to do and play developing co-ordination skills as well as physical activity</li> <li>• Recessed fixings will ensure child does not catch or hurt themselves on the equipment</li> <li>• Tough and durable finish will ensure the equipment stays looking good for longer and attract children</li> <li>• Designed with specific age of children in mind so they can climb, use and fit on the equipment e.g. step distance, not too far to fall off the bottom of the slide</li> <li>• Not suitable for over 12s or under 4s.</li> </ul> <p><b>Additional evaluative points worthy of credit:</b></p> <ul style="list-style-type: none"> <li>• Only suited to day use-as the equipment goes outside unless artificial light present</li> </ul> <p>Accept all other valid responses</p>	<b>3-4 marks</b>	Well described and justified analysis containing full evaluation, drawing conclusions having considered a range of factors	<b>1-2 marks</b>	Brief points mentioned but not fully explained. Analysis present but limited evaluation/conclusions drawn.	<b>0 marks</b>	No attempt or nothing worthy of credit	4	AO4
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21	2	<p>Responses may consider both positive and negative points – both equally valid.</p> <table border="1" data-bbox="304 342 1131 584"> <tr> <td data-bbox="304 342 475 448"><b>3-4 marks</b></td> <td data-bbox="475 342 1131 448">Well described and justified analysis of data containing full evaluation, drawing conclusions having considered a range of factors</td> </tr> <tr> <td data-bbox="304 448 475 553"><b>1-2 marks</b></td> <td data-bbox="475 448 1131 553">Brief points mentioned but not fully explained. Analysis present but limited evaluation/conclusions drawn</td> </tr> <tr> <td data-bbox="304 553 475 584"><b>0 marks</b></td> <td data-bbox="475 553 1131 584">No attempt or nothing worthy of credit</td> </tr> </table> <p><b>Indicative content:</b></p> <ul style="list-style-type: none"> <li>• Non slip surfaces will help prevent a fall</li> <li>• Use of anti-tamper fittings reduce risk of malicious tampering or vandalism</li> <li>• Recessed construction fittings to prevent cuts to skin and injuries</li> <li>• All play equipment features area safe height from the ground to prevent falls from a great height</li> <li>• Tough and durable finishes will prevent decay and rusting meaning equipment will last longer and safe to use</li> <li>• Non slip surfaces will reduce chance of injury when wet and climbing as it is an outside piece of equipment</li> <li>• Some features involve height which present additional danger to children unsupervised or supported</li> <li>• Some features may be more dangerous in extreme weather e.g. hot surfaces, slippery surfaces, ridged surfaces e.g. rubber flooring             <ul style="list-style-type: none"> <li>• If parts of the equipment are not bolted together correctly, could potentially be unsafe</li> </ul> </li> </ul> <p>Accept all other valid responses</p>	<b>3-4 marks</b>	Well described and justified analysis of data containing full evaluation, drawing conclusions having considered a range of factors	<b>1-2 marks</b>	Brief points mentioned but not fully explained. Analysis present but limited evaluation/conclusions drawn	<b>0 marks</b>	No attempt or nothing worthy of credit	4	AO4
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Qu	Part	Marking Guidance	Total marks	AO
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22	1	<p><b>1 mark each for maximum and minimum lengths</b></p> <p>Maximum length will be <math>(275 + 1.375) = 276.375</math> mm  <b>Rounded to 276.38/ 276.38mm for mark</b></p> <p>Minimum length will be <math>(275 - 1.375) = 273.625</math>mm  <b>Rounded to 273.63/273.63mm for mark</b></p>	2	AO4
22	2	<p><b>1 mark for each step below up to a maximum of 3</b></p> <ol style="list-style-type: none"> <li>1. Material used for 12 steps is <math>12 \times 0.275 = 3.3</math> m or 3300mm</li> <li>2. Waste is <math>3.6\text{m} - 3.3\text{m} = 0.3\text{m}</math> or 300mm</li> </ol> <p>Or</p> <p><math>3300/3600 = 0.9167</math> (amount used for steps)</p> <ol style="list-style-type: none"> <li>3. Percentage waste is <math>(0.3/3.6) \times 100 = 8.33\%</math></li> </ol> <p><b>If correct answer is arrived at then award all 3 marks even if steps 1 and/or 2 are not evident.</b></p>	3	AO4

Qu	Part	Marking Guidance	Total marks	AO								
23		<table border="1" data-bbox="304 367 1129 913"> <tr> <td data-bbox="304 367 480 539"><b>5-6 marks</b></td> <td data-bbox="480 367 1129 539">A thorough, detailed explanation with clear, relevant discussion of collaborative design and importance in helping designers create effective solutions to problems. Clear example(s) are given to support response.</td> </tr> <tr> <td data-bbox="304 539 480 712"><b>3-4 marks</b></td> <td data-bbox="480 539 1129 712">A good explanation with relevant supporting discussion of collaborative design. Some consideration of importance in helping designers create effective solutions. Simple example(s) given to support response.</td> </tr> <tr> <td data-bbox="304 712 480 884"><b>1-2 marks</b></td> <td data-bbox="480 712 1129 884">Basic explanation of collaborative design with little or no reference as to importance in how designers use it to create effective solutions to problems. Incorrect example(s) that do not support response.</td> </tr> <tr> <td data-bbox="304 884 480 913"><b>0 marks</b></td> <td data-bbox="480 884 1129 913">Nothing worthy of credit</td> </tr> </table> <p data-bbox="304 949 564 978"><b>Indicative content:</b></p> <p data-bbox="304 1014 1150 1111"><b>Candidates can use examples of products designed through collaboration and/or examples of collaboration in designing itself.</b></p> <p data-bbox="304 1146 443 1176"><b>Products:</b></p> <ul data-bbox="352 1207 1190 1615" style="list-style-type: none"> <li>• Mobile phones – many different parts requiring people with different skills to design them</li> <li>• Product packaging – package itself, secondary packaging all need designing and will be done outsourced to different companies with different skills, equipment and expertise.</li> <li>• Motor vehicles, complex products needing the input of team with various skills to meet technical, legal and user requirements.</li> <li>• Public transport, requiring technical engineering expertise, ergonomic knowledge and interior design</li> <li>• Medical equipment, requiring medical knowledge, technical and manufacturing expertise and human factors application.</li> </ul> <p data-bbox="304 1650 456 1680"><b>Designing:</b></p> <ul data-bbox="352 1711 1198 2058" style="list-style-type: none"> <li>• The need to obtain specialist expertise; e.g. electronic engineers working with product designers, architects working with structural engineers</li> <li>• Companies purchasing outside design ideas e.g. Products marketed as being “Porsche design”</li> <li>• Where designers work together to solve problems</li> <li>• Working with other people and not in isolation designers can feed off each other in terms of ideas or experience.</li> <li>• Chance of designs based on the work of one individual becoming stale and not effective for purpose</li> </ul>	<b>5-6 marks</b>	A thorough, detailed explanation with clear, relevant discussion of collaborative design and importance in helping designers create effective solutions to problems. Clear example(s) are given to support response.	<b>3-4 marks</b>	A good explanation with relevant supporting discussion of collaborative design. Some consideration of importance in helping designers create effective solutions. Simple example(s) given to support response.	<b>1-2 marks</b>	Basic explanation of collaborative design with little or no reference as to importance in how designers use it to create effective solutions to problems. Incorrect example(s) that do not support response.	<b>0 marks</b>	Nothing worthy of credit	6	AO4
<b>5-6 marks</b>	A thorough, detailed explanation with clear, relevant discussion of collaborative design and importance in helping designers create effective solutions to problems. Clear example(s) are given to support response.											
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<b>0 marks</b>	Nothing worthy of credit											

		<ul style="list-style-type: none"> <li>• Commercially, companies may become slow to react to changing market demands – collaborative design could ‘future proof’ against this.</li> <li>• eg IKEA now looking to involve designers from outside the organisation (Tom Dixon)</li> <li>• Fashion stores will commission designs from designers outside of their own organisation.</li> <li>• Belief that solutions to problems generated in isolation can be of a lower quality and not address all the needs of the client or user (especially if complex or extensive), due to limitations of expertise or experience.</li> <li>• Used to increase the range and quality of solutions/ possibilities generated to solve a need eg by using teams of designers in competition</li> <li>• Use different people with different skills, experience and expertise during the design process. Thus, ensuring a better end result.</li> <li>• Designers can inspire each other leading to innovative and creative solutions to problems</li> <li>• Shorter design timescale, as designers can work concurrently.</li> </ul> <p>Accept all other valid responses</p>		
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Qu	Part	Marking Guidance	Total marks	AO
24		<p>Safety considerations when using <b>cutting tools</b>:</p> <p>Expect students to consider either hand or machine/power tools to answer this question.</p> <p>Responses are likely to focus on 3 areas:</p> <p><b>Look for link to a precaution e.g. wear goggles, not goggles alone</b></p> <p><b>Preparation for cutting</b></p> <ul style="list-style-type: none"> <li>• Select the correct tool for the intended task to ensure it can be undertaken safely</li> <li>• Make sure you are wearing the correct personal protection equipment (PPE) eg goggles, dust mask, safety footwear</li> <li>• Tie hair back</li> <li>• Powered cutting equipment should be PAT tested/ check condition of flex for cuts etc on power tools</li> <li>• Make sure you are familiar with how to isolate the equipment if powered and where the emergency stop buttons are</li> <li>• Make sure you are fully trained and familiar with the correct safe use of cutting tool</li> <li>• Carry cutting tools point down</li> </ul> <p><b>The cutting activity itself</b></p> <ul style="list-style-type: none"> <li>• Use hand cutting tools pointing away from yourself</li> <li>• Make sure all dust extraction is active when using power cutting tools</li> <li>• With power tools always select correct speed for safe tool use</li> <li>• Hold work piece securely either by hand if possible or using a suitable holding device e.g vice</li> <li>• Make sure tool has appropriate guarding and use</li> <li>• Keep your fingers and hands away/behind the cutting edge when in use</li> <li>• Always focus on the cutting activity and avoid distractions</li> <li>• <b>NB Apron correct IF qualified as precaution when angle grinding/cutting.</b></li> </ul> <p><b>Storage/isolation of tool after use</b></p> <ul style="list-style-type: none"> <li>• Remove cutting tool from powered equipment and return to safe storage</li> <li>• Always return hand cutting equipment to the correct storage rack/cover cutting blade with protective cover</li> <li>• Retract blades if possible</li> <li>• Turn off and isolate any powered cutting tools after use</li> </ul>	5	AO4

Qu	Part	Marking Guidance	Total marks	AO								
25	1	<table border="1" data-bbox="308 371 1134 645"> <tr> <td data-bbox="308 371 459 439"><b>3 marks</b></td> <td data-bbox="459 371 1134 439">Detailed aesthetic reason(s) for applying finishes. At least one appropriate example provided</td> </tr> <tr> <td data-bbox="308 439 459 539"><b>2 marks</b></td> <td data-bbox="459 439 1134 539">One aesthetic reason for applying a finish and one appropriate example given <b>or</b> two reasons and no example</td> </tr> <tr> <td data-bbox="308 539 459 607"><b>1 mark</b></td> <td data-bbox="459 539 1134 607">One basic reason for applying finishes for an aesthetic reason. No example provided.</td> </tr> <tr> <td data-bbox="308 607 459 645"><b>0 marks</b></td> <td data-bbox="459 607 1134 645">Nothing worthy of credit</td> </tr> </table> <p data-bbox="308 680 568 712"><b>Indicative content:</b></p> <p data-bbox="308 748 699 779">Any named <b>aesthetic</b> reason:</p> <ul data-bbox="355 786 1182 887" style="list-style-type: none"> <li>• Change the colour of a product</li> <li>• Improving appearance/make the product look more attractive</li> <li>• Change the look and feel of a product</li> </ul> <p data-bbox="308 922 647 954">Aesthetic finish examples:</p> <ul data-bbox="355 960 1203 1375" style="list-style-type: none"> <li>• Painting cars different colours to suit different customer tastes</li> <li>• Embossing in card to create a decorative 3D effect</li> <li>• Self-finished surface, eg the injection moulding process can 'build in' a textured surface in contrast to a smooth surface</li> <li>• Add to decoration and quality of finish, eg enamelling jewellery</li> <li>• Wood stains to enhance the colour of timber</li> <li>• Anodising to produce brightly coloured aluminium products, eg bike wheels, Maglites</li> <li>• Stonewashing jeans (distressing) gives a soft peach skin effect</li> <li>• Heat setting thermoplastic fibres to give crushed effect, creases and pleating</li> </ul>	<b>3 marks</b>	Detailed aesthetic reason(s) for applying finishes. At least one appropriate example provided	<b>2 marks</b>	One aesthetic reason for applying a finish and one appropriate example given <b>or</b> two reasons and no example	<b>1 mark</b>	One basic reason for applying finishes for an aesthetic reason. No example provided.	<b>0 marks</b>	Nothing worthy of credit	3	AO4
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25	2	<table border="1" data-bbox="306 376 1133 689"> <tr> <td data-bbox="306 376 459 479"><b>3 marks</b></td> <td data-bbox="459 376 1133 479">Detailed functional reason(s) for applying finishes. At least one appropriate example provided</td> </tr> <tr> <td data-bbox="306 479 459 582"><b>2 marks</b></td> <td data-bbox="459 479 1133 582">One functional reason for applying a finish and one appropriate example given <b>or</b> two reasons and no example</td> </tr> <tr> <td data-bbox="306 582 459 651"><b>1 mark</b></td> <td data-bbox="459 582 1133 651">One basic reason for applying finishes for a functional reason. No example provided.</td> </tr> <tr> <td data-bbox="306 651 459 689"><b>0 marks</b></td> <td data-bbox="459 651 1133 689">Nothing worthy of credit</td> </tr> </table> <p data-bbox="306 757 568 786"><b>Indicative content:</b></p> <ul data-bbox="354 824 1200 1646" style="list-style-type: none"> <li>• To make more suited to intended use/improve durability</li> <li>• To inhibit combustion/reduce fire risk (textiles)</li> <li>• Protect from moisture/water</li> <li>• Stain resist finish</li> <li>• To prevent insect/fungal attack (wood)</li> <li>• To resist corrosion</li> <li>• Build in a textured finish (polymers)</li> <li>• Provide a non-slip finish</li> <li>• Functional finish examples</li> <li>• Flame retardants to textiles</li> <li>• Waterproof finish on a jacket</li> <li>• Laminating a book cover to protect from moisture</li> <li>• Anodising aluminium to improve durability</li> <li>• Electro plating to provide a durable finish</li> <li>• Wood preservative on a garden fence to protect from moisture and insect attack</li> <li>• Dip/powder coating of metals to inhibit corrosion</li> <li>• Galvanising (not aesthetic reason) mild steel to resist corrosion</li> <li>• Self-finished surface, eg injection moulding process can ‘build in’ a textured surface to provide a non-slip surface/grip on a chair, child’s toy etc.</li> </ul>	<b>3 marks</b>	Detailed functional reason(s) for applying finishes. At least one appropriate example provided	<b>2 marks</b>	One functional reason for applying a finish and one appropriate example given <b>or</b> two reasons and no example	<b>1 mark</b>	One basic reason for applying finishes for a functional reason. No example provided.	<b>0 marks</b>	Nothing worthy of credit	3	AO4
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Qu	Part	Marking Guidance	Total marks	AO
26	1	<p>A maximum of 2 marks for <b>each</b> advantage</p> <p>One mark for each correct advantage with a second mark awarded where response is clarified/ additional detail is provided</p> <p><b>Indicative content:</b></p> <p><b>This question is about drawing and about Cad.</b></p> <p><b>1 mark responses:</b></p> <ul style="list-style-type: none"> <li>• You can see at least 3 sides of the object drawn</li> <li>• Drawing is more realistic</li> <li>• Create an artist's impression of an object</li> </ul> <p><b>2 mark responses:</b></p> <ul style="list-style-type: none"> <li>• 3D drawing provides a more realistic view of how the drawn product might look in real life</li> <li>• 3D drawing gives the viewer opportunity to imagine how the drawn product might feel when held/used</li> <li>• 3D drawing can be used to create a perspective view of an object, eg 1, 2 or 3-point perspective</li> <li>• Can be used to show how a product can be assembled, eg exploded drawings</li> <li>• Makes it easier to understand how to assemble flat pack furniture as you can see how the different parts/components relate to each other.</li> <li>• You can see at least 3 sides providing detail of sizes and proportion</li> </ul>	2 x 2	AO4

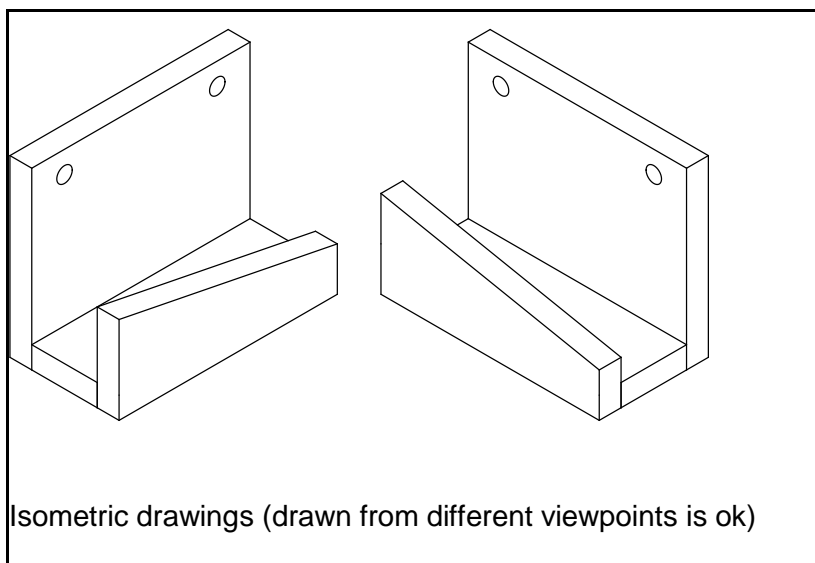
<p>26</p>	<p>2</p>	<p><b>Side view:</b></p> <p>1 mark – shape is correct (1<sup>st</sup> or 3<sup>rd</sup> angle/reward mirror image/either way round – see below)</p> <p>1 mark – hole hidden detail (<b>use of dotted lines</b>) is correct</p> <p><b>Look for a 'J' shape</b></p> <div style="border: 1px solid black; padding: 10px; margin: 10px 0;"> </div> <p style="text-align: center;"><b>Plan view</b></p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p><b>Front view</b></p> </div> <div style="text-align: center;"> <p><b>Side view</b></p> </div> </div> <p style="margin-top: 20px;"> </p> <p><b>Side view</b></p>	<p>5</p>	<p>AO4</p>
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Isometric drawing:

**NB Image is indicative of correct image from one corner only. A candidate may have drawn shape correctly from a different view point and full credit is available if it satisfies the criteria below.**

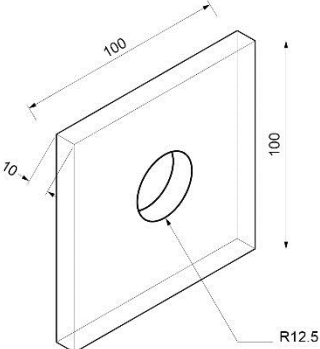
**Drawing must be isometric, not perspective, oblique etc**

- 1 mark – general shape is correct (slope and holes etc)
- 1 mark – slope on front section drawn correct way round
- 1 mark – holes are in correct place



Isometric drawings (drawn from different viewpoints is ok)

Do not penalise if holes are not totally correct.  
Accept circular or elliptical holes

Qu	Part	Marking Guidance	Total marks	AO
27		<p>1 mark for overall total volume                      1 mark for material not required by 12.5 radius hole in shape                      1 mark for total material required in mm<sup>3</sup></p> <p><b>Top tip: check answer first and work back to check working</b></p>  <p><b>Add:</b>  <math>100 \times 100 \times 10 = 100,000</math> or <math>100,000\text{mm}^3</math></p> <p><b>Subtract:</b>  <math>V = 3.142 \times 12.5^2 \times 10 = 4909.375</math> or <math>4909.375\text{mm}^3</math>                      or  <math>V = 3.14 \times 12.5^2 \times 10 = 4906.25</math> or <math>4906.25\text{mm}^3</math>                      or  <math>V = 156.25 \pi \times 10 = 4908.74</math> or <math>4908.74\text{mm}^3</math>                      or  <math>V = 312.5/2 \pi \times 10 = 4908.74</math> or <math>4908.74\text{mm}^3</math>                      or  <math>V = 625/4 \pi \times 10 = 4908.74</math> or <math>4908.74\text{mm}^3</math></p> <p><b>Total material required/ total volume:</b>  <math>100,000 - 4909.375 = 95,090.625</math>                      or  <math>100,000 - 4906.25 = 95,093.75</math></p> <p><b>Accept 4909 or 4906 for hole volume as the answer still works out despite rounding too early.</b></p> <p><b>Possible answers:</b>  <math>95,091</math> or <math>95,091 \text{ mm}^3</math> (using 3.142 or <math>\pi</math>)                      or  <math>95094</math> or <math>95,094 \text{ mm}^3</math> (using 3.14)</p>	3	AO4

Qu	Part	Marking Guidance	Total marks	AO										
28		<table border="1" data-bbox="300 488 1125 965"> <tr> <td data-bbox="300 488 454 622"><b>4 marks</b></td> <td data-bbox="454 488 1125 622">A fully coherent and detailed response how modelling is an important tool used to develop prototypes. At least <b>two</b> specific examples given to support answer.</td> </tr> <tr> <td data-bbox="300 622 454 725"><b>3 marks</b></td> <td data-bbox="454 622 1125 725">A detailed response explaining why modelling is an important tool used to develop prototypes. One specific example given.</td> </tr> <tr> <td data-bbox="300 725 454 828"><b>2 marks</b></td> <td data-bbox="454 725 1125 828">Some understanding of why modelling is an important tool used to develop prototypes. May include attempt to provide an example.</td> </tr> <tr> <td data-bbox="300 828 454 931"><b>1 marks</b></td> <td data-bbox="454 828 1125 931">One brief point made why modelling is an important tool to develop prototypes. No example given.</td> </tr> <tr> <td data-bbox="300 931 454 965"><b>0 marks</b></td> <td data-bbox="454 931 1125 965">Nothing worthy of credit.</td> </tr> </table> <p data-bbox="300 1032 560 1066"><b>Indicative content:</b></p> <p data-bbox="389 1099 1161 1167">Examples could be – products or modelling techniques e.g. card, foam board, Toile, Circuit wizard</p> <ul data-bbox="344 1205 1203 1686" style="list-style-type: none"> <li>• Expect lots of reference to modelling used to develop a 3D impression/part or all of a prototype; visualisation</li> <li>• Reduce product development times e.g. rapid prototyping</li> <li>• Modelling can be undertaken using physical models made from clay, paper, card, prototyping boards, cheaper less durable easier sourced materials</li> <li>• Allows the interaction of moving components to be viewed</li> <li>• Non-destructive testing of materials virtually to avoid wasting real materials and components unnecessarily e.g. testing electronic circuits virtually</li> <li>• Sharing of design concepts electronically via the internet (file sharing) allowing multiple persons to work on a proposal at once (collaborative design)</li> <li>• Allows testing for stress under load.</li> </ul>	<b>4 marks</b>	A fully coherent and detailed response how modelling is an important tool used to develop prototypes. At least <b>two</b> specific examples given to support answer.	<b>3 marks</b>	A detailed response explaining why modelling is an important tool used to develop prototypes. One specific example given.	<b>2 marks</b>	Some understanding of why modelling is an important tool used to develop prototypes. May include attempt to provide an example.	<b>1 marks</b>	One brief point made why modelling is an important tool to develop prototypes. No example given.	<b>0 marks</b>	Nothing worthy of credit.	4	AO4
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