GCSE
DESIGN AND TECHNOLOGY
8552/W

Unit 1 Written Paper

Mark scheme

June 2022

Version: 1.0 Final

226G8552/W/MS

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 Examiner.

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

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.

Glossary for maths

If a student uses a method which is not explicitly covered by the mark scheme the same principles of marking should be applied. Credit should be given to any valid methods. Examiners should seek advice from their senior examiner if in any doubt.

[a, b]	Accept values between a and b inclusive.
For π	Accept values in the range [3.14, 3.142]
Their	Accept an answer from the candidate if it has been inaccurately calculated but is subsequently used in a further stage of the question.

Questions which do not ask students to show working

As a general principle, a correct response is awarded full marks.

Qu	Part	Marking Guidance	Total marks	AO
01		**C** illuminate Light Emitting Diodes	1 mark	AO4 1a

Qu	Part	Marking Guidance	Total marks	AO
02		**A** anti-bacterial	1 mark	AO4 1a

Qu	Part	Marking Guidance	Total marks	AO
03		**A** can be pressed into a shape or form	1 mark	AO4 1a

Qu	Part	Marking Guidance	Total marks	AO
04		**A** Bleed proof	1 mark	AO4 1b

Qu	Part	Marking Guidance	Total marks	AO
05		**A** Lamp	1 mark	AO4 1a

Qu	Part	Marking Guidance	Total marks	AO
06		**C** Iron	1 mark	AO4 1a

Qu	Part	Marking Guidance	Total marks	AO
07		**D** Plywood	1 mark	AO4 1a

Qu	Part	Marking Guidance	Total marks	AO
08		**D** Water	1 mark	AO4 1a

Qu	Part	Marking Guidance	Total marks	AO
09		**D** withstand impacts without breaking	1 mark	AO4 1b

Qu	Part	Marking Guidance	Total marks	AO
10		**D** Pollution is created by the burning of fossil fuels	1 mark	AO4 1b

Qu	Part	Marking Guidance	Total marks	AO
11	1	One mark for a correct **specific** modern material. NB. We are accepting specific named smart materials as they are an accepted as a subset of modern materials. . **Indicative content** **Accept** / **Don't accept** Carbon Fibre / Memory Foam (generic) Corn starch Polymers / Nylon D30 / Plywood Flexible MDF Gore-Tex® Graphene Kevlar Liquid Crystal displays (LCDs) Metal Foams Nano materials Titanium Nitinol/SMA Thermochromic pigments Photochromic pigments Quantum Tunnelling Composite QTC Polymorph Semi-precious clays Accept specific all other valid responses after WW2.	1 mark	AO4 1a

Qu	Part	Marking Guidance	Total marks	AO
11	2	2 marks: Two correct simple points of explanation **or** one point explained in detail possibly using a specific example of use. 1 mark: One correct simple point of explanation. 0 marks: No response or nothing worthy of credit. **Indicative content**	2 marks	AO4 1b

		Please do not accept unqualified generic answers such as strong, stronger, cheap, cheaper etc. For this question we are accepting reference to smart materials as some may have been interpreted as modern materials due to recent discovery. There is some overlap. The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above. • A range of materials specifically developed to meet specific product requirements, eg Pyrex® for heat resistance = 2 • Improved materials with enhanced properties not available in traditional materials, eg wood, metal = 2 • Improved durability of products in working conditions, eg heat, stress etc = 2 • Longer lasting products = 1 • Easy to work with = 0 Accept all other valid responses.		
Qu	**Part**	**Marking Guidance**	**Total marks**	**AO**
12		One mark for a simple reason, with a second mark available for a well explained/clarified reason. This can include correct examples. **Indicative content** **Reasons making HDPE suitable for household bottles and containers are** • Moisture resistance – they do not dissolve in water, become soggy and leak. • Chemical resistance – do not react with contents. • Durability – can be dropped without breaking. • Can be recycled – now widely recycled and used in different polymer products saving finite resources. • Ability to recycle means less materials and energy are used in primary processing of raw materials. • Can be self-coloured during manufacture – finish does not wear away as it is a full depth feature. • Manufactured in one piece, eg injection moulding lid parts, blow moulding bottle body, so a fast process making it more commercially viable for mass production. • Mould can incorporate integral ergonomic handles, eg milk containers, detergent bottles, using material for two purposes. • One material used in construction so no need to separate different materials for recycling. • In some applications containers can be refilled and reused making it better for the environment. Accept all other valid responses.	2 x 2 marks	AO4 1c

Qu	Part	Marking Guidance	Total marks	AO
13	1	Correct answer: Oscillating	1 mark	AO4 1c

Qu	Part	Marking Guidance	Total marks	AO
13	2	2 marks: Detailed understanding of the function of the connecting linkage clearly linked to the motion of the wiper arms. 1 mark: Simple understanding of the function of the connecting linkage, eg move the wipers. 0 marks: No response or nothing worthy of credit. **Indicative content** • To ensure both wiper arms move in parallel. • Make sure the wiper arms move together in unison. • Make sure the wiper arms do not clash or bang into each other. • Ensure both wipers work at the same time to clear both sides of the windscreen. • Stabilise/ stability in the mechanism • Only one motor is needed Accept all other valid responses.	2 marks	AO4 1c

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>14</td><td></td><td>
<table>
<tr><td>5 marks</td><td>Fully coherent response using detailed notes and/or sketches with clear understanding of how one chosen process is used correctly to cut to a tolerance.</td></tr>
<tr><td>4 marks</td><td>Clear notes and/or sketches used to correctly explain one chosen process of removing material and a simple attempt to consider how a tolerance might be used during process.</td></tr>
<tr><td>3 marks</td><td>Notes and/or sketches used correctly to explain one chosen process of removing material with implied reference to use of a tolerance.</td></tr>
<tr><td>2 marks</td><td>Simple notes or sketches demonstrating a very basic understanding of any form of removing material from one of the given processes.</td></tr>
<tr><td>1 mark</td><td>Simple sketch or note related to any form of removing material from one of the given processes.</td></tr>
<tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr>
</table>
Indicative content

The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above.

<table>
<tr><td>Turning</td><td>Responses may consider wood, metal or polymers on a centre lathe or wood lathe. Expect reference to jigs, and templates to cut a profile on a wood lathe.

On a centre lathe use of compound slide and cross slide using incremental measurements on turning handles.

Appropriate speed selection, feed rates (coolant with metals) to ensure acceptable tolerance in finish is correct.</td></tr>
<tr><td>Die cutting</td><td>Use of papers and cardboards to produce ‘nets’ or developments suitable for folding and assembly into boxes etc.

For tolerance expect reference to shape and profile of creasing rule to avoid cutting, but sufficient profile with creasing channels to allow paper or card to be bent. Even force applied to pressure plates by rolling or pressing to ensure uniform cuts, perforations, creases etc.

Ridged cutting blades to form easy tear perforations rather than a complete cut may be considered in response.</td></tr>
</table>
</td><td>5 marks</td><td>AO4 1b</td></tr>
</table>

	Reference to crop marks
Laser cutting	Used on woods, metals, polymers, fabrics and paper and card. A data file will need to be created eg 2D design and uploaded to the laser cutter Different colours of line in the Cad drawing assigned to different tasks eg red to cut, black to score Expect tolerance references to be made to focusing the laser (key tool), speed of the laser and pulses of laser light emitted per 25 mm/inch (PPI). Extractor on, lid shut to ensure it works
Cutting by shearing	Opportunities to demonstrate cutting by shearing in woods, metals, textiles and paper and card. **NO MARKS FOR ANYTHING TO DO WITH SHEARING SHEEP!** Tolerance references may consider use of effective marking out including material removed by a saw cut or guillotine. Use of templates drawn round producing a line to follow. Textiles response 1. Iron fabric to remove creases which could affect accuracy. 2. Pin template/pattern securely to fabric, ensuring grain lines match. 3. Ensure sharp fabric scissors are used. 4. Cut as near to the template edge as possible. 5. Crop marks

Accept other valid responses.

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>15</td><td>1</td><td>
<table>
<tr><td>3 marks</td><td>Two or more force locations identified and full description on how they act on the bow and arrow before it is fired.</td></tr>
<tr><td>2 marks</td><td>One correctly identified force location clearly described about part of the bow or arrow or two simple forces identified but not clearly linked to part of the bow or arrow.</td></tr>
<tr><td>1 mark</td><td>Outline of some action/movement in the bow or arrow before it is fired.</td></tr>
<tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr>
</table>
Indicative content

The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above.

<table>
<tr><th>Acceptable Forces (in spec)</th><th>Not acceptable</th></tr>
<tr><td>Bending</td><td>Gravity</td></tr>
<tr><td>Compression</td><td>Friction</td></tr>
<tr><td>Tension</td><td>Elastic</td></tr>
<tr><td>Torsion</td><td></td></tr>
<tr><td>Shear</td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
</table>

When the bow string is pulled back it is under tension.
The bow is stressed with a bending force (or an element of bending ie tension /compression)
The arrow is under compression until the archer releases their grip.
The bow is under dynamic load/force when any parts are moving.
The bow is under compression from the archer’s hand.
The string is in tension

IF TWO FORCES ARE IDENTIFIED CORRECTLY BY LABELS ON DIAGRAM THAT CAN GAIN 2 MARKS

Accept other valid responses.
</td><td>3 marks</td><td>AO4 1c</td></tr>
</table>

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>15</td><td>2</td><td>
<table>
<tr><td>3 marks</td><td>A thorough understanding of how materials can be improved by reinforcing – two or more detailed points or one detailed point and two simple points.</td></tr>
<tr><td>2 marks</td><td>A detailed understanding of one method or two simple points as to how a material can be reinforced.</td></tr>
<tr><td>1 mark</td><td>One simple point on reinforcing, eg last longer.</td></tr>
<tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr>
</table>
Indicative content

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Concrete
• Reinforced with steel bars/rods to improve resistance to tensile forces in modern architecture.

Fabrics
• Use of polymers/Vilene in shirt collars to prevent bending, creasing and stop collar from curling.
• Retain ‘sharp’ point on collar.
• Rivets in jeans
• French seam
• Flat felled seam
• Hems
• Overlocking
• Interfacing to reinforce/stabilise/stiffen fabric.

Lamination
• Layer of timber (lamins) used in glulam construction to create longer wood beams for architecture better able to resist bending forces.
• Lamination of paper and card using a polymer wallet. This improves tear resistance and resistance to moisture preventing wood fibres from disintegrating.

Composite materials
• CRFP (Carbon reinforced polymer). Two or more dissimilar materials are joined together to create a material that is better than its constituent materials, ie best properties of both.

Ribbing/webbing/fillets/gussets
• Ribbing and webbing are used extensively in the manufacture of polymer products to reduce the quantity of material used
</td><td>3 marks</td><td>AO4 1b</td></tr>
</table>

		and weight. These reinforcements increase stiffness eg polymer food packaging eg bakery, fruit • Fillets are Intentional rounding of an internal corner to reinforce and provide additional structural support. • Gusset/flitch plates used in engineering and textiles are a triangular shaped inset on a structural joint or seam. Accept other valid responses.		

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>16</td><td>1</td><td>
<table>
<tr><td>2 marks</td><td>A clear explanation as to the purpose of a template. More than one point considered. Possible example of application of use.</td></tr>
<tr><td>1 mark</td><td>One valid point demonstrating knowledge as to the purpose of a template.</td></tr>
<tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr>
</table>
Indicative content

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• Templates are used to save time when marking out.
• You can draw round a template to produce multiple copies of a part or design.
• They are used to allow repetition and improve accuracy between identical parts.
• They are reusable so you do not have to redraw identical parts fresh each time.

Accept other valid responses.
</td><td>2 marks</td><td>AO4 1b</td></tr>
</table>

Qu	Part	Marking Guidance	Total marks	AO
16	2	Correct answer = 45 Mark the number **NOT** the units	1 mark	AO4 1c

Qu	Part	Marking Guidance	Total marks	AO
16	3	Answer 120 (Two marks) 60 seen in working (One mark)	2 marks	AO4 1c

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>17</td><td></td><td>
A maximum of three marks explaining why each factor needs to be considered when selecting materials or component.
<table>
<tr><td>3 marks</td><td>One point considered in great detail, or two points considered in detail, or three simple points of explanation given.</td></tr>
<tr><td>2 marks</td><td>One point considered in detail or two simple points of explanation given.</td></tr>
<tr><td>1 mark</td><td>One simple point of explanation given.</td></tr>
<tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr>
</table>
Indicative content

The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above.
<table>
<tr><td>Availability</td><td>Sourcing – some materials are easier to get hold of, eg local supply. There can be seasonal factors, supply, (political problems, local supply etc.), and changing demand to consider. Materials that are difficult to extract, take a long time to grow or transport are not as easily available.

Stock forms – some materials are only available in stock forms. Specialised or personalised materials will incur additional costs. Manufacturers can calculate waste easier using stock forms.

Components – where possible manufacturers try to use standard components as they are readily available, easy to source and replace if required. Many modern products try to use a limited number of standard components. This brings benefits of economies of scale and increased potential suppliers to get the best price possible.</td></tr>
<tr><td>Cultural and social factors</td><td>Cultural factors – values and beliefs of particular communities/countries. In China red signifies good luck, but in parts of Africa it is a colour of mourning. Care would need to be taken in sourcing paints or fabrics in these</td></tr>
</table>
</td><td>2 x 3 marks</td><td>AO4 1b</td></tr>
</table>

	colours depending on where products are to be sold. **Social factors** – dealing with family, gender, age, wealth, religion and lifestyle. In a multicultural society, different groups may look at a product in a totally different way to another. Manufacturers have to be sensitive to this, eg animal testing of cosmetics, the use of animals in products, eg skins and hides. Many people are increasingly concerned with the environment and the planet. They may want to know where materials have been sourced and if they are sustainable, eg FSC timber.

Accept other valid responses.

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>18</td><td></td><td>
<table>
<tr><td>7–8 marks</td><td>A fully detailed analysis and evaluation of carbon dioxide production qualified with appropriate examples. An excellent consideration of a range of factors from material sourcing to product disposal.</td></tr>
<tr><td>5–6 marks</td><td>A good analysis and evaluation of carbon dioxide production qualified with limited examples. Good consideration of factors influencing the ‘carbon footprint’ of the chosen product.</td></tr>
<tr><td>3–4 marks</td><td>Basic analysis of generic points impacting on the carbon footprint of products. No evidence of an attempt to evaluate, (offer a personal judgement), on each point raised.</td></tr>
<tr><td>1–2 marks</td><td>One or two simple points showing limited understanding of factors impacting on the carbon footprint of products.</td></tr>
<tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr>
</table>
Indicative content

The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above.

Analysis – identification of component characteristics of each type of pollution.

Evaluation – judgment on impact of each type of pollution on the environment.

Expect references to Life Cycle assessment (LCA) and ‘cradle to grave’ assessment.

Candidates are likely to mention product miles, (not air miles), and the CO_2 generated at all stages of a product’s life.

Credit responses that discuss ways of reducing the CO_2 footprint.

Raw material extraction
• Fuel and energy used to harvest, fell, mine and drill for raw materials.
• Reference to use of fossil fuels, eg petrol, oil, diesel etc.
• Reference to recycled or reused materials to significantly reduce the CO_2 footprint at this stage.

Transport
• Fuel and energy used to transport raw materials for primary processing and modification into standard, stock and refined forms.
</td><td>8 marks</td><td>AO3 2a
AO3 2b</td></tr>
</table>

		• Transport by trucks, trains and boats. • Recycling and reusing waste material in house. • Local sourcing of materials. • More direct travel routes, eg Suez Canal for products from the Far East. **Packaging, shipping and distribution** • CO_2 produced in the manufacture of both primary and secondary packaging of products. • Manufacturers are currently striving to find ways to reduce and simplify packaging to avoid excessive material consumption as well as reducing CO_2 produced in manufacturing, using and disposing of packaging. **Product use and operation** • How much energy does a particular product use in use, eg energy efficiency rating. • Does the product contribute to CO_2 emissions, eg product left on stand-by. • Aftercare for textile products use of washing machine/driers requires energy. **End of life/disposal** • How much energy will be required to separate materials and components? • Can the product be upcycled reducing CO_2 emissions? Accept other valid responses.		

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>19</td><td>1</td><td>
<table>
<tr><td>5–6 marks</td><td>Excellent detailed analysis and evaluation of the garden furniture and packaging. Thorough consideration of functionality and evaluation considering positive and/or negative features.</td></tr>
<tr><td>3–4 marks</td><td>Good analysis and some evaluation of the garden furniture and packaging. Functionality is considered with brief points looking at positive and/or negative features.</td></tr>
<tr><td>1–2 marks</td><td>Limited analysis of garden furniture and/or packaging. Limited consideration of functionality.</td></tr>
<tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr>
</table>
Indicative content

The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above.

Analysis will identify functional features and evaluation will consider how effective the identified features are in doing their intended job, ie fitness for purpose.

Garden furniture
• Table needs to be big enough to accommodate four people sitting round it comfortably.
• Table needs to have a large flat surface to support plates, food, serving dishes etc without them falling over.
• Table needs to be tough and durable to resist wearing and abrasions from plates and dishes touching surface.
• Chairs need to be comfortable to sit in and at the right height so legs fit under the table.
• Table need a hole in the centre to support a parasol and protect people from light rain and sun.
• Parasol needs to be removable for packing away.
• Parasol needs to be collapsible on a windy day.

Packaging
• Advertise the garden furniture to potential customers in shops etc.
• Inform and provide details of product specification, features, manufacturer and safety etc.
• Promote and advertise the garden furniture to potential customers in shops.
• Protect the contents against damage during transportation, eg use of corrugated card.
• Secure and keep all pieces from moving and bumping into each other and causing damage during transit.
• Size and shape of packaging is important

Accept other valid responses.
</td><td>6 marks</td><td>AO3 1a
AO3 1b</td></tr>
</table>

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>19</td><td>2</td><td>
<table>
<tr><td>5–6 marks</td><td>Detailed analysis and evaluation of how the design and manufacture of garden furniture may cause deforestation in the consumption of timber-based resources. Evaluation considers a range of things that can be done to secure design and manufacture of garden furniture eg alternative materials and/or deforestation.</td></tr>
<tr><td>3–4 marks</td><td>Good analysis of how the design of garden furniture may cause deforestation. Evidence of evaluation of things that can be done to support continued design and manufacture of garden furniture.</td></tr>
<tr><td>1–2 marks</td><td>Brief points demonstrating a basic grasp of deforestation, but not linked/related to the design and manufacture of garden furniture.</td></tr>
<tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr>
</table>
Indicative content

The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above.

• Much garden furniture uses hardwoods that may not come from sustainable sources leading to deforestation.
• This will lead to a lack of hardwoods available to make timber-based garden furniture.
• Hardwoods take longer to grow than softwoods and so may be consumed, (felled), at a greater rate than they can grow leading to a reduced supply of hardwoods, increasing the costs of manufacture and cost to the consumer.
• Garden furniture could be designed and manufactured using sustainable sources of more rapidly growing timber.
• This may lead to designs having to be altered to make use of a polymer or metal-based product and fabricated in different ways to make reliable and effective products.
• Designs could be altered to make use of reclaimed or upcycled timber.
• Products may not be as environmentally friendly and make it difficult for manufacturers to justify the ethics involved in producing their products.
• Designs created using less materials
• Use of bracing to reduce timber sections needed.
• This may lead to garden furniture in the future using up more finite resources, eg iron ore, and requiring additional consumption of materials and resources contributing to further global warming.
• Mining and drilling for metal ores and crude oil also can lead to deforestation.
</td><td>6 marks</td><td>AO3 1a
AO3 1b</td></tr>
</table>

		• Designs may require excessive or additional packaging using timber-based materials, eg corrugated card, that could lead to a greater rate of deforestation Accept other valid responses.		

Qu	Part	Marking Guidance	Total marks	AO
20	1	1 mark: Use of correct formula and substitution: C = πD or $2\pi R$ = [3.14, 3.142, 22/7] C = π 90 **or** C = $\frac{2 \pi 45}{\pi}$ 1 mark: C = [282.6, 282.78] 1 mark: C = 283 mm (Note: Follow through any value correctly rounded to the nearest mm for this mark.) **NB NO WORKING BUT CORRECT ANSWER GETS FULL MARKS**	3 marks	AO4 2c

Qu	Part	Marking Guidance	Total marks	AO
20	2	1 mark: 3 legs = 120 × 3 = 360 mm 1 mark: 3 hoops = their [282.6, 282.78] × 3 = [847.8, 848.34] or 3 hoops = 283 × 3 = 849 1 mark: Total = 360 + their 849 or Total = 1209 mm or Total = [1207.8, 1208.34] 1 mark: Total with correct rounding up (in cm) = 121 cm **NB IF NONE OF THE STEP VALUES SHOWN IN WORKING ARE CORRECT ie 360,849, 1209 ETC, BUT THE METHOD IS CORRECT AWARD UP TO 2 MARKS MAXIMUM.**	4 marks	AO4 2c

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>21</td><td>1</td><td>
<table>
<tr><td>1 mark</td><td>Any correctly named deforming or reforming process used to manufacture chosen product.

NB If no product chosen award zero. You can credit if process is named in 21.2 or 21.3</td></tr>
<tr><td>0 marks</td><td>No response or nothing worthy of credit ie totally unclear anywhere what process is chosen.</td></tr>
</table>
Indicative content

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<table>
<tr><th>Product</th><th>Process</th></tr>
<tr><td>Metal toy car</td><td>• Die casting
• Gravity casting
• Casting</td></tr>
<tr><td>Birthday card</td><td>• Creasing
• Forming
• Scoring
• Embossing
• Die cutter machine – as it can be used for creasing and perforation</td></tr>
<tr><td>Polymer toothbrush</td><td>• Injection moulding
• Over moulding</td></tr>
<tr><td>Cotton skirt</td><td>• Pressing/Ironing
• Folding
• Pleating
• Creasing

(Do not accept gathering.)</td></tr>
<tr><td>Plywood chair</td><td>• Lamination
• Steam bending
• Bending
• Former lamination
• Vacuum bag lamination</td></tr>
</table>
Accept other valid responses.
</td><td>1 mark</td><td>AO4 2a</td></tr>
</table>

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>21</td><td>2</td><td>
<table>
<tr><td>2 marks</td><td>Two correct reasons given or one reason qualified.

Note: If process description is appropriate for process named in 21.1, marks can be awarded.</td></tr>
<tr><td>1 mark</td><td>One brief correct point of explanation.</td></tr>
<tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr>
</table>
Indicative content

The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above.
<table>
<tr><th>Product</th><th>Deforming/reforming process</th></tr>
<tr><td>Metal toy car</td><td>Casting
• Create a one-piece form.
• Create a fine detailed finish of car features.
• A smooth finish which will accept a good paint finish.</td></tr>
<tr><td>Birthday card</td><td>Embossing
• Create a relief pattern either raised or depressed to add texture and 3D qualities.

Scoring
• Make it easier to crease or fold at a precise point without tearing paper fibres.

Creasing/Folding
• So card can be bent/folded in a precise way at a precise point.</td></tr>
<tr><td>Polymer toothbrush</td><td>Injection moulding
• An ergonomically shaped cavity in the required toothbrush shape.
• Encapsulate bristles so they can’t fall out when brushing.
• Injection is quick and rapid for mass production

Over moulding
• Provide a ‘soft touch’ grip to make holding the toothbrush more comfortable.</td></tr>
<tr><td>Cotton skirt</td><td>Pressing/Ironing
• To crease fabric and keep folds in place ready for pinning and stitching.

Folding/pleating/creasing</td></tr>
</table>
</td><td>2 marks</td><td>AO4 2c</td></tr>
</table>

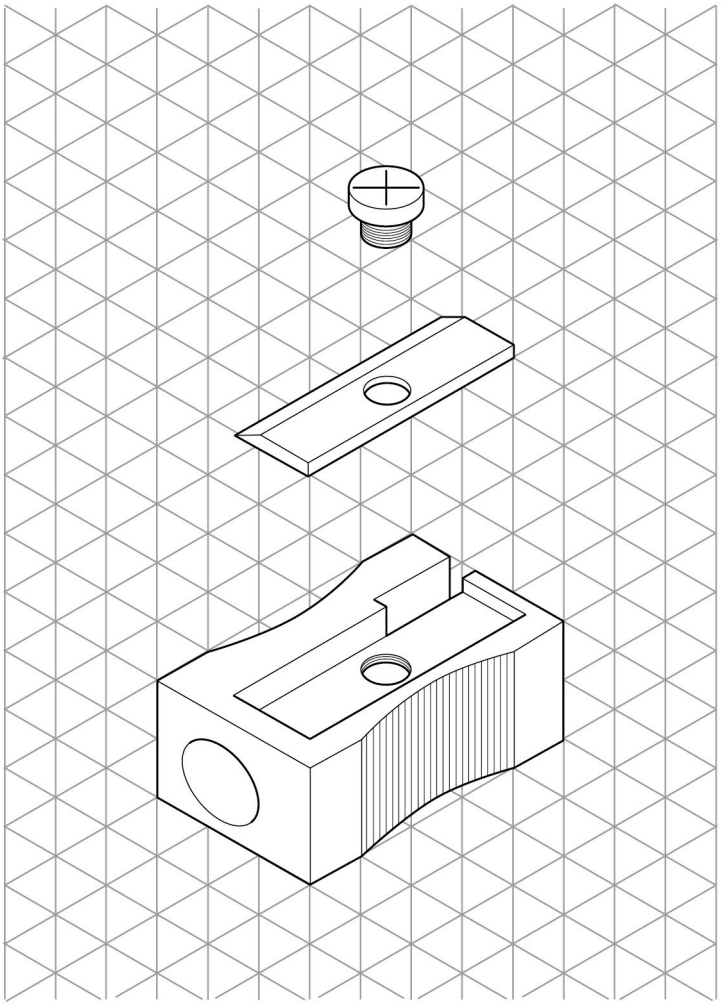
		<table><tr><td></td><td>• To introduce a decorative series of features/improved aesthetics. • Create extra volume to skirt for added insulation.</td></tr><tr><td>Plywood chair</td><td>Laminating • Layers of wood (veneers of lamins) are bonded together under pressure in formers or a vacuum bag to create a unique profile once the adhesive has cured. Steam bending • Where veneers or lamins are first placed in a steam chamber so wood fibres are softened so wood can be deformed without splitting. Bending • Where veneers, lamins or small sections of wood are forced under pressure round a former.</td></tr></table> Accept other valid responses.		

Qu	Part	Marking Guidance	Total marks	AO
21	3	<table><tr><td>2 marks</td><td>Two safety issues in brief **or** one point considered in detail.</td></tr><tr><td>1 mark</td><td>One issue identified in brief.</td></tr><tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr></table> **Indicative content** The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above. **Safety issue must be appropriate for process identified in 21.1 or 21.2 if that is where it has been identified in error.** • Reference to any Personal Protection Equipment (PPE), eg wearing goggles, protective gloves, (against heat). • Safe use of equipment, eg securing if heavy against falling on feet etc, finger traps with clamps and fastening, risk of burning where heat is involved. • Precautions taken when using heat/iron. Accept other valid responses.	2 marks	AO4 2c

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>22</td><td>1</td><td>
<table>
<tr><td>1 mark</td><td>A recognisable attempt at an isometric drawing.</td></tr>
<tr><td>1 mark</td><td>Drawing is clearly exploded, ie parts not joined together.</td></tr>
<tr><td>1 mark</td><td>Correctly proportioned parts.</td></tr>
<tr><td>1 mark</td><td>Screw aligns with hole on blade/ direction indicated precisely with arrow</td></tr>
<tr><td>1 mark</td><td>Correct alignment of blade and body/ direction indicated precisely with arrow</td></tr>
</table>
Indicative content

Accept responses with totally separate parts but also overlapping where not fully assembled.

IF RESPONSE IS CLEAR AND FULLY ASSEMBLED (NOT EXPLODED) THE MAX OF 3 MARKS


</td><td>5 marks</td><td>AO4 2c</td></tr>
</table>

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>22</td><td>2</td><td>
<table>
<tr><td>3–4 marks</td><td>Excellent understanding of where and why exploded drawings are used with example(s).</td></tr>
<tr><td>1–2 marks</td><td>An understanding of where or why exploded drawings are used. Maximum of two marks for a good explanation with no example(s) given.</td></tr>
<tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr>
</table>
Indicative content

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Exploded drawings:
• are used to show how the parts of a product fit together
• show how parts are put together
• show detail that cannot be shown if a product is drawn assembled
• show more information about the product
• show how a product works
• show structural detail of joining methods
• are less confusing to some people who are not technically minded or cannot read hidden detail in orthographic drawings
• can be used rather than providing written instructions to customers in several languages.

Examples of use:
• instructions for assembled of products with many parts, eg Ikea furniture, Lego kits
• service manuals, eg car repair manuals
• schematic architectural drawings to show the way round, eg hospitals.
• Products such as:
o Vacuum cleaner manuals
o Wind-up toys
o Pen
o Torch

Accept other valid responses.
</td><td>4 marks</td><td>AO4 2b</td></tr>
</table>

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
</table>

<table>
<tr>
<td>23</td>
<td></td>
<td>
Maximum of two marks for one advantage and one disadvantage.
<table>
<tr><td>2 marks</td><td>A detailed advantage or disadvantage of freehand sketching with clear linking to computer aided drawing (Cad).</td></tr>
<tr><td>1 mark</td><td>Basic advantage or disadvantage of freehand sketching with no reference to Cad</td></tr>
<tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr>
</table>
Indicative content

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Advantages
• Freehand sketching can be done with simple equipment, eg a pencil and paper where CAD requires software and hardware which is more expensive.
• Cheap requiring only a pencil & paper =1
• Cheaper than Cad requiring only a pencil and paper and not a computer = 2
• Sketching can be done anywhere. With CAD drawing you need software and a PC etc.
• Quick and easy to add shade and tone to create a realistic effect. No need to use lots of PC power to complete a render etc.
• A sketched drawing can be completed in as little or as much time as you want to spend.
• A great way of recording new ideas quickly if you do not have access to a CAD package and computer.
• Freehand sketching does not require you to know how to use complex Cad software.
• Less susceptible to cyber-crime and theft.
Disadvantages
• Not as accurate = 1
• Drawings may be unclear if you are not very good at drawing, where you can be more precise drawing in a CAD package.
• A paper drawing can be damaged if it gets wet whereas you can save a CAD drawing electronically.
• You cannot share a sketched drawing like you can with CAD files where several people can access information at one time all around the world.
• Cannot output sketch to machine for Cam directly
• Storage space for physical drawing unlike a data file is larger.
• Mistakes can be expensive requiring a sketch to be redrawn whereas in CAD it is easy to edit or undo mistakes without restarting a piece of work.

Note: relevant advantages of Cad can be used as disadvantage of freehand sketching

Accept other valid responses.
</td>
<td>2 x 2 marks</td>
<td>AO4 2b</td>
</tr>
</table>

Qu	Part	Marking Guidance	Total marks	AO
24	1	One mark for correct knowledge. **Indicative content** • A starting point from where all measurements are taken. • Marks put on material as a starting point, eg face side and face edge marks. • Matching starting points of a piece of fabric to ensure pattern repeats corrects. • Alignment of wood grain to maintain a pattern. • Any ref to top left/top right as a starting point. • Vanishing points on perspective drawings. • Reference origin Accept other valid responses.	1 mark	AO4 2a

Qu	Part	Marking Guidance	Total marks	AO
24	2	<table><tr><td>2 marks</td><td>A detailed explanation of why we need to use datum points during production.</td></tr><tr><td>1 mark</td><td>One brief point of why we need to use datum points during production.</td></tr><tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr></table> **Indicative content** The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above. • Improve accuracy. • CNC uses a datum point to calculate movement and travel to complete a job, eg laser. • Reduce measurement error. • Reduce material waste by allowing accurate tessellation and part alignment. • Alignment of patterns and parts. • Matching starting points of a piece of fabric to ensure pattern repeats are correct. • Alignment of wood grain to maintain a pattern. Accept other valid responses.	2 marks	AO4 2b

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>25</td><td>1</td><td>
<table>
<tr><td>3 marks</td><td>A thorough understanding of how the chosen piece of equipment would be used – two or more detailed points or one detailed point and two simple points made.</td></tr>
<tr><td>2 marks</td><td>A good understanding of how the chosen piece of equipment would be used – one point explained in detail or two simple points made.</td></tr>
<tr><td>1 mark</td><td>Very limited understanding of how the chosen piece of equipment would be used – one simple point made.</td></tr>
<tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr>
</table>
Indicative content

The guidance provided is illustrative and extensive. We are NOT looking for all points to be covered to access top band marks.

Credit any worthy points made in support of the band descriptors above.

<table>
<tr><th>Label</th><th>Equipment</th><th>How is chosen equipment used?</th></tr>
<tr><td>A</td><td>Laser cutter</td><td>• A Cad files eg DFX is sent from a PC to the laser cutter
• Put material into laser cutter to reference point
• Laser is focussed so you can minimise waste, cut accurately and tesselate many parts.
• Go int into settings appropriate to material
• Lid closed and press start.</td></tr>
<tr><td>B</td><td>Overlocker</td><td>• Place the threads at at back of machine
• Put fabric under presser foot to be joined.
• Run machine to join fabric together
• Make sure there is a chain of stiches that run into the air before cutting off.</td></tr>
<tr><td>C</td><td>Vac former</td><td>• Turn on heating elements
• Former or similar into the machine bed
• Plastic sheet clamped into position
• Heaters pulled over plastic sheet to soften it
• Raise table
• Turn on Vacuum
• Blow former to ease removal of workpiece</td></tr>
</table>
</td><td>3 marks</td><td>AO4 2b</td></tr>
</table>

		• Lower table once formed • Remove former from workpiece
D	**3D printer**	• Create a 3D prototype representation of any file, (STL or VRML), product sent from a CAD output. • Prepare the bed for printing • Upload STL file etc • Machine extrudes molten filament precisely • Remove 3D image from bed removing any scaffolding if used .
E	Lathe	• Prepare material for lathe eg cut corners off wood (if wood lathe) cut bar, section etc to size prior to install into chuck. • Set tool height to centre • Start machine – may talk about correct speed and rotation • Safety guard down so machine starts • Coolant turned started on metal lathe .

Accept other valid responses.

Qu	Part	Marking Guidance	Total marks	AO
25	2		3 marks	AO4 2b

3 marks	Detailed explanation of check(s) used to ensure a quality outcome.
2 marks	One detailed check given or two simple checks to ensure a quality outcome.
1 mark	At least one simple check used to ensure a quality outcome.
0 marks	No response or nothing worthy of credit.

Indicative content

The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above.

Equipment	Check(s)/(Why)
Laser cutter	• Correct software installed • Laser lens clean – keep the beam focused. • Focus the laser – so beam is focused on the surface of the material being worked. • Check speed, PPI and power of laser to ensure line is cut through, engraving sufficient depth.

Overlocker	• Four threads in place – overlocking stitches can be formed. • Chain of stitching formed – machine is ready to stitch fabric. • Thread tension settings are suitable for fabric type – stitches will be correctly formed without puckering fabric or threads snapping. • Quality of stitching – stitches will be neat and correctly formed. • Thread colour – to match selected fabric. • Produce a test sample
Vac former	• Former/jig/mould/template in correct place • Sheet correct way round eg shiny side up • Vacuum forming seals are working. • Appropriate pin holes in former to ensure all air can escape from around the former. • Temperature correct – so material is soft and flexible.
3D printer	• Check factory settings first if new. Do not assume print bed is level. • Nozzle clearance to the bed. • Nozzle temperature is appropriate to melt PLA filament or similar. • Correct printer software is installed. • Correct bed dimensions are installed so PLA is not printed where it should not. • Do a test print
Lathe	• Component secure and central in the appropriate chuck. • Tool post height is correct, so tool tip is in line with centre axis of component being worked. • Correct rotation speed to avoid excessive heat and vibration reducing quality of surface finish dependant on material being worked and its diameter. • Ensure DRO (Digital Read Out) is set to zero.

Accept other valid responses.

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>26</td><td></td><td>
<table>
<tr><td>3–4 marks</td><td>Excellent explanation of why evaluation is used by designers to develop prototypes with example(s) given. Must include example(s) for maximum marks.</td></tr>
<tr><td>1–2 marks</td><td>A basic understanding of why evaluation is used by designers in the development of prototypes. No requirement of example(s) to access two marks.</td></tr>
<tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr>
</table>
Indicative content

QUESTION IS ABOUT WHY WE TEST AND NOT HOW.

The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above.

• Identify what is working well and what needs improving.
• Promote improved quality in the design.
• Allow designers to make sure prototypes are suitable for their intended user(s).
• Review of tests against both the design specification and manufacturing specification.
• Evaluate materials to be used and check their suitability, cost function etc against their intended use.
• Opinions of customer and end user need to be evaluated before prototypes become commercial products.

Note: Examples could be something other than products e.g public

• Accept other valid responses.
</td><td>4 marks</td><td>AO4 2b</td></tr>
</table>

END OF MARK SCHEME