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A-level  
**DESIGN AND TECHNOLOGY:  
PRODUCT DESIGN**  
**7552/2**

Paper 2 Designing and Making Principles

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Mark scheme

June 2023

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Version: 1.0 Final



2 3 6 A 7 5 5 2 / 2 / M S

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](http://aqa.org.uk)

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## 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.

<b>[a, b]</b>	Accept values between a and b inclusive.
<b>For <math>\pi</math></b>	Accept values in the range [3.14, 3.142]
<b>Their</b>	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.

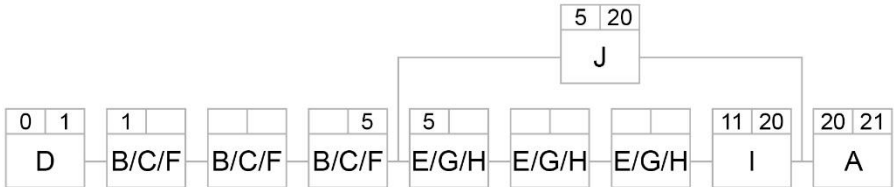
Qu	Part	Marking Guidance	Total marks	AO										
01		<p><b>Figures 1 and 2</b> show two wheelbarrows.</p> <p>Compare the suitability of the two wheelbarrows shown for use on a building site.</p> <table border="1" data-bbox="320 504 1217 1424"> <thead> <tr> <th data-bbox="320 504 504 555">Marks</th> <th data-bbox="504 504 1217 555">Description</th> </tr> </thead> <tbody> <tr> <td data-bbox="320 555 504 875">5–6 marks</td> <td data-bbox="504 555 1217 875">Full use of the tabulated information concerning the wheelbarrows has been made to form justified analytical and evaluative statements. Detailed technical knowledge and understanding of the information is provided and this is related to the building site context. There may be some minor irrelevant points or lack of clarity in some points but this will not detract from the overall quality of the response.</td> </tr> <tr> <td data-bbox="320 875 504 1160">3–4 marks</td> <td data-bbox="504 875 1217 1160">Most of the tabulated information concerning the wheelbarrows has been utilised to form analytical statements. Some technical detail beyond the information provided is given with some reference to the building site context. At the lower end of the mark band there may be limited expansion on some of the tabulated data. The majority of points will be relevant.</td> </tr> <tr> <td data-bbox="320 1160 504 1375">1–2 marks</td> <td data-bbox="504 1160 1217 1375">Basic use of the tabulated information has been made to compare the wheelbarrows shown with limited expansion of the information to show further knowledge and understanding. At the lower end of the mark band points will be restricted to comparing information given with no further detail.</td> </tr> <tr> <td data-bbox="320 1375 504 1424">0 marks</td> <td data-bbox="504 1375 1217 1424">No response or nothing worthy of credit.</td> </tr> </tbody> </table> <p><b>Indicative content</b></p> <p>The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above.</p> <ul data-bbox="320 1630 1217 2074" style="list-style-type: none"> <li>• The spherical tyre allows <b>Figure 1</b> to steer more easily without tipping over.</li> <li>• A spherical tyre increases surface contact with the ground meaning <b>Figure 1</b> will not sink into soft ground as easily as <b>Figure 2</b>.</li> <li>• The spherical tyre may be harder to replace as it is not as common as the tyre for <b>Figure 2</b>.</li> <li>• The HDPE bucket in <b>Figure 1</b> is less likely to damage objects such as wooden door frames when driven into them unlike the Low Carbon Steel bucket in <b>Figure 2</b>.</li> <li>• The HDPE bucket can be left outside without the risk of corrosion.</li> <li>• The HDPE bucket may be prone to UV degradation leading to cracking and discolouration.</li> </ul>	Marks	Description	5–6 marks	Full use of the tabulated information concerning the wheelbarrows has been made to form justified analytical and evaluative statements. Detailed technical knowledge and understanding of the information is provided and this is related to the building site context. There may be some minor irrelevant points or lack of clarity in some points but this will not detract from the overall quality of the response.	3–4 marks	Most of the tabulated information concerning the wheelbarrows has been utilised to form analytical statements. Some technical detail beyond the information provided is given with some reference to the building site context. At the lower end of the mark band there may be limited expansion on some of the tabulated data. The majority of points will be relevant.	1–2 marks	Basic use of the tabulated information has been made to compare the wheelbarrows shown with limited expansion of the information to show further knowledge and understanding. At the lower end of the mark band points will be restricted to comparing information given with no further detail.	0 marks	No response or nothing worthy of credit.	6 marks	AO3 1a AO3 1b
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	<ul style="list-style-type: none"><li>• The HDPE bucket is self-finishing meaning scratches are less visible.</li><li>• <b>Figure 2</b> coating is likely to chip when being used with cement/aggregate etc.</li><li>• <b>Figure 1</b> can be used with wet cement etc without risk of degradation.</li><li>• Any reference to colour pigments must be justified related to the context.</li></ul> <p><b>This list is not exhaustive. Accept any other valid responses.</b></p>		
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Qu	Part	Marking Guidance	Total marks	AO																								
02		<p><b>Figure 3</b> shows a ramp for a wheelbarrow.</p> <p>The maximum angle (<math>x</math>) that a wheelbarrow can be safely pushed up is 20 degrees.</p> <p>Calculate the length, <b>AB</b>, required to allow the wheelbarrow to be safely pushed up the ramp.</p> <p>Give your answer to the nearest mm.</p> <p>Show your working.</p> <table border="1" data-bbox="320 745 1214 2067"> <tbody> <tr> <td data-bbox="320 745 643 898">Select the correct trigonometry equation</td> <td data-bbox="643 745 1061 898"> <math display="block">\text{Sine} = \frac{\text{Opposite}}{\text{Hypotenuse}}</math> </td> <td data-bbox="1061 745 1214 898">1 mark</td> </tr> <tr> <td data-bbox="320 898 643 1198">Substitute the correct values</td> <td data-bbox="643 898 1061 1198"> <math display="block">\text{Sine}20 = \frac{225}{\text{AB}}</math> </td> <td data-bbox="1061 898 1214 1198">1 mark</td> </tr> <tr> <td data-bbox="320 1198 643 1451">Manipulate the equation</td> <td data-bbox="643 1198 1061 1451"> <math display="block">\text{AB Sine}20 = 225</math> <math display="block">\text{AB} = \frac{225}{\text{Sine}20}</math> <math display="block">\text{AB} = [657.8, 657.9]</math> </td> <td data-bbox="1061 1198 1214 1451">1 mark</td> </tr> <tr> <td data-bbox="320 1451 643 1534">Correct accuracy</td> <td data-bbox="643 1451 1061 1534"> <math display="block">\text{AB} = 658 \text{ mm}</math> </td> <td data-bbox="1061 1451 1214 1534">1 mark</td> </tr> <tr> <td data-bbox="320 1534 643 1682">Where no working has been shown, but the final answer is accurate</td> <td data-bbox="643 1534 1061 1682"> <math display="block">\text{AB} = 658 \text{ mm}</math> </td> <td data-bbox="1061 1534 1214 1682">4 marks</td> </tr> <tr> <td data-bbox="320 1682 643 1765">Special case 1</td> <td data-bbox="643 1682 1061 1765">Incorrect accuracy rounded down to 657mm</td> <td data-bbox="1061 1682 1214 1765">3 marks</td> </tr> <tr> <td data-bbox="320 1765 643 1883">Special case 2</td> <td data-bbox="643 1765 1061 1883">If a response gives a length for AB greater than 658mm with no working out</td> <td data-bbox="1061 1765 1214 1883">1 mark</td> </tr> <tr> <td data-bbox="320 1883 643 2067">Special case 3</td> <td data-bbox="643 1883 1061 2067">If a response gives a length greater than 658mm and shows working out that demonstrates the use of an angle less than 20 degrees</td> <td data-bbox="1061 1883 1214 2067">4 marks</td> </tr> </tbody> </table>	Select the correct trigonometry equation	$\text{Sine} = \frac{\text{Opposite}}{\text{Hypotenuse}}$	1 mark	Substitute the correct values	$\text{Sine}20 = \frac{225}{\text{AB}}$	1 mark	Manipulate the equation	$\text{AB Sine}20 = 225$ $\text{AB} = \frac{225}{\text{Sine}20}$ $\text{AB} = [657.8, 657.9]$	1 mark	Correct accuracy	$\text{AB} = 658 \text{ mm}$	1 mark	Where no working has been shown, but the final answer is accurate	$\text{AB} = 658 \text{ mm}$	4 marks	Special case 1	Incorrect accuracy rounded down to 657mm	3 marks	Special case 2	If a response gives a length for AB greater than 658mm with no working out	1 mark	Special case 3	If a response gives a length greater than 658mm and shows working out that demonstrates the use of an angle less than 20 degrees	4 marks	4 marks	AO4 2c
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03		<p><b>Table 1</b> shows the main stages involved in manufacturing a wheelbarrow.</p> <p>The stages are listed in alphabetical order.</p> <p>Using the information from <b>Table 1</b>, complete the Critical Path Network (CPN) diagram in <b>Figure 4</b> to show the correct order for completing the manufacture in the most time-efficient manner.</p> <table border="1" data-bbox="320 638 1217 1106"> <thead> <tr> <th>Marks</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>4 marks</td> <td>All stages are in a correct order with correct final time seen.</td> </tr> <tr> <td>3 marks</td> <td>All stages are in a correct order, no final time seen</td> </tr> <tr> <td>2 marks</td> <td>The key stages J, I and A are all correctly located. Timings are incomplete or inaccurate. <b>(if stages A and J are correct and correct final time award 2 marks)</b></td> </tr> <tr> <td>1 mark</td> <td>The final stage A is correctly located, the order of other stages is confused.</td> </tr> <tr> <td>0 marks</td> <td>No response or nothing worthy of credit.</td> </tr> </tbody> </table> <p>All stages must appear only once in the table.</p> <p>Essential steps in order:</p> <ul style="list-style-type: none"> <li>• Stage D is placed in diagram already</li> <li>• Stages B/C/F can be interchanged as shown in the diagram below (timings to be adjusted based on candidate order)</li> <li>• Stage J must be correctly identified and placed in parallel processing</li> <li>• Stages E/G/H can be interchanged, but must be complete before Stage I</li> <li>• Stage A must be the last.</li> </ul> <p><b>Indicative content</b></p> <ul style="list-style-type: none"> <li>• The key timing boxes should be completed as shown below.</li> </ul> 	Marks	Description	4 marks	All stages are in a correct order with correct final time seen.	3 marks	All stages are in a correct order, no final time seen	2 marks	The key stages J, I and A are all correctly located. Timings are incomplete or inaccurate. <b>(if stages A and J are correct and correct final time award 2 marks)</b>	1 mark	The final stage A is correctly located, the order of other stages is confused.	0 marks	No response or nothing worthy of credit.	4 marks	AO4 2b
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04		<p><b>Figure 5</b> shows a powder coated low carbon steel frame for a wheelbarrow.</p> <p>Explain how jigs and templates may have been used to accurately produce multiple copies of the frame shown in <b>Figure 5</b>.</p> <table border="1" data-bbox="320 539 1217 875"> <thead> <tr> <th data-bbox="320 539 504 589">Marks</th> <th data-bbox="504 539 1217 589">Description</th> </tr> </thead> <tbody> <tr> <td data-bbox="320 589 504 707">3–4 marks</td> <td data-bbox="504 589 1217 707">The response gives a detailed explanation of how jigs and templates may have been used for specific aspects of the frame shown.</td> </tr> <tr> <td data-bbox="320 707 504 826">1–2 marks</td> <td data-bbox="504 707 1217 826">The response gives a basic explanation of how jigs and/or templates may be used in production with limited reference to the frame shown.</td> </tr> <tr> <td data-bbox="320 826 504 875">0 marks</td> <td data-bbox="504 826 1217 875">No response or nothing worthy of credit.</td> </tr> </tbody> </table> <p><b>Indicative content</b></p> <ul data-bbox="320 981 1217 1294" style="list-style-type: none"> <li>• A template may be used to check the angle of bend in the tube when creating the front section of the frame.</li> <li>• A jig would be used to hold the steel brackets in place when being welded to the tubular frame.</li> <li>• A jig would be needed to hold the frame in the correct orientation when all holes are being drilled.</li> <li>• A template may be used to mark holes for drilling on the frame.</li> <li>• A bending jig to shape/curve the steel framework.</li> <li>• A cutting jig to cut the lengths of steel initially.</li> </ul> <p><b>This list is not exhaustive. Accept any other valid responses.</b></p>	Marks	Description	3–4 marks	The response gives a detailed explanation of how jigs and templates may have been used for specific aspects of the frame shown.	1–2 marks	The response gives a basic explanation of how jigs and/or templates may be used in production with limited reference to the frame shown.	0 marks	No response or nothing worthy of credit.	4 marks	AO4 2c
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05		<p><b>Figure 6</b> shows a CAD model of a component for a piece of flat pack furniture.</p> <p>The component could be produced on a CNC router or by using wood machine wasting processes.</p> <p>Compare and evaluate <b>both</b> manufacturing methods for the three features labelled.</p> <table border="1" data-bbox="320 640 1217 1160"> <thead> <tr> <th>Marks</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>5–6 marks</td> <td>The response provides a detailed comparison of CNC and wood machine wasting processes with specific reference and detail regarding each of the three labelled features. Not all features need to be described in equal detail.</td> </tr> <tr> <td>3–4 marks</td> <td>The response provides a good comparison of CNC and wood machine wasting processes referring to some of the features labelled individually.</td> </tr> <tr> <td>1–2 marks</td> <td>The response gives a basic comparison of CNC manufacture and wood machine wasting processes with limited reference to the labelled features.</td> </tr> <tr> <td>0 marks</td> <td>No response or nothing worthy of credit.</td> </tr> </tbody> </table> <p><b>Indicative content</b></p> <p>CNC manufacture requires accurate computer program to follow.</p> <p>Wood machine wasting processes require accurate dimensioned drawings and marking out.</p> <p>CNC manufacture may require tool changes between different features to allow for different diameters etc.</p> <p><b>All features: CNC</b></p> <p>CNC Router</p> <ul style="list-style-type: none"> <li>• This will be a single continuous groove following co-ordinates.</li> <li>• The depth settings will be automatically adjusted.</li> <li>• The feature can be any size above the tool diameter.</li> </ul> <p><b>Feature A: Rebate</b></p> <p>Manual techniques (wood machine wasting processes)</p> <ul style="list-style-type: none"> <li>• To produce the rebate by hand will require accurate clamping and a hand-held router with a guide jig increasing set up time.</li> <li>• The groove will be produced in two straight cuts, unless a complex guide is created.</li> <li>• Depth settings will need to be adjusted due to multiple cuts when machining by hand.</li> </ul>	Marks	Description	5–6 marks	The response provides a detailed comparison of CNC and wood machine wasting processes with specific reference and detail regarding each of the three labelled features. Not all features need to be described in equal detail.	3–4 marks	The response provides a good comparison of CNC and wood machine wasting processes referring to some of the features labelled individually.	1–2 marks	The response gives a basic comparison of CNC manufacture and wood machine wasting processes with limited reference to the labelled features.	0 marks	No response or nothing worthy of credit.	6 marks	AO3 1a AO3 1b
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	<ul style="list-style-type: none"> <li>• If the groove is wider than the cutter the guide will have to be adjusted between cuts.</li> <li>• A plough plane may be used instead of a hand router.</li> </ul> <p><b>Feature B: Blind hole</b></p> <p>Manual techniques (wood machine wasting processes)</p> <ul style="list-style-type: none"> <li>• Created using either forstner bit, saw tooth bit or wood drill bit.</li> <li>• Depth stop set on pillar drill to give consistency between holes or using depth stop collars.</li> <li>• Positioning of the hole will need templating or jigs to align correctly.</li> </ul> <p><b>Feature C: Counterbored hole</b></p> <p>Manual techniques (wood machine wasting processes)</p> <ul style="list-style-type: none"> <li>• Initial use of forstner, saw tooth or flat bit.</li> <li>• Depth stop to prevent inaccuracies.</li> <li>• Through drill using centre mark created by forstner, sawtooth or flat bit.</li> <li>• Alternative use of pilot hole and counterbore drill with the use of a depth stop.</li> </ul> <p><b>This list is not exhaustive. Accept any other valid responses.</b></p>		
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06		<p><b>Figures 7 and 8</b> show two welding masks.</p> <p>Compare the suitability of <b>both</b> masks for use when welding.</p> <table border="1" data-bbox="320 465 1217 1323"> <thead> <tr> <th data-bbox="320 465 504 517">Marks</th> <th data-bbox="504 465 1217 517">Description</th> </tr> </thead> <tbody> <tr> <td data-bbox="320 517 504 801">5–6 marks</td> <td data-bbox="504 517 1217 801">Full use of the tabulated information concerning the masks has been made to form justified analytical and evaluative statements that show detailed technical knowledge and understanding of the information provided. There may be some minor irrelevant points or lack of clarity in some points but this will not detract from the overall quality of the response.</td> </tr> <tr> <td data-bbox="320 801 504 1055">3–4 marks</td> <td data-bbox="504 801 1217 1055">Most of the tabulated information concerning the masks has been utilised to form analytical statements showing some technical detail beyond the information provided. At the lower end of the mark band there may be limited expansion on some of the tabulated information. The majority of points will be relevant.</td> </tr> <tr> <td data-bbox="320 1055 504 1272">1–2 marks</td> <td data-bbox="504 1055 1217 1272">Basic use of the tabulated information has been made to compare the masks shown with limited expansion of the information to show further knowledge and understanding. At the lower end of the mark band points will be restricted to comparing given information.</td> </tr> <tr> <td data-bbox="320 1272 504 1323">0 marks</td> <td data-bbox="504 1272 1217 1323">No response or nothing worthy of credit.</td> </tr> </tbody> </table> <p><b>Indicative content</b></p> <ul data-bbox="320 1429 1217 2045" style="list-style-type: none"> <li>• Having to hold the mask reduces the users control of torch to a single hand reducing accuracy when welding.</li> <li>• The SMART/photochromic screen reacts to the arc flash allowing the user to position the torch accurately without moving the mask away from face.</li> <li>• The SMART/photochromic screen can have the reactivity adjusted to the user’s preference.</li> <li>• If reactivity is incorrectly set this can lead to arc blindness.</li> <li>• The adjustable strap allows all users to use one mask.</li> <li>• Two hands allow for easier adjustment of welding components and fixtures.</li> <li>• When using the one-handed face mask you may position the torch correctly then move the mask to cover your face and inadvertently move the torch also.</li> <li>• The hand-held mask is not suitable for TIG welding where both hands are required for the process.</li> <li>• <b>Figure 7</b> may cause fatigue after prolonged use due to holding with arm in single position.</li> </ul>	Marks	Description	5–6 marks	Full use of the tabulated information concerning the masks has been made to form justified analytical and evaluative statements that show detailed technical knowledge and understanding of the information provided. There may be some minor irrelevant points or lack of clarity in some points but this will not detract from the overall quality of the response.	3–4 marks	Most of the tabulated information concerning the masks has been utilised to form analytical statements showing some technical detail beyond the information provided. At the lower end of the mark band there may be limited expansion on some of the tabulated information. The majority of points will be relevant.	1–2 marks	Basic use of the tabulated information has been made to compare the masks shown with limited expansion of the information to show further knowledge and understanding. At the lower end of the mark band points will be restricted to comparing given information.	0 marks	No response or nothing worthy of credit.	6 marks	AO3 1a AO3 1b
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07		<p>Outline how designers make use of market research strategies when developing design concepts.</p> <table border="1" data-bbox="320 434 1217 837"> <thead> <tr> <th data-bbox="320 434 504 488">Marks</th> <th data-bbox="504 434 1217 488">Description</th> </tr> </thead> <tbody> <tr> <td data-bbox="320 488 504 674">3–4 marks</td> <td data-bbox="504 488 1217 674">The response gives a detailed explanation of different market research methods and identifies their suitability to different stages of the design process. Some inaccuracies may be seen but will not detract from the quality of the answer.</td> </tr> <tr> <td data-bbox="320 674 504 786">1–2 marks</td> <td data-bbox="504 674 1217 786">The response gives a generic explanation of market research with some reference to how it may be used in the design process.</td> </tr> <tr> <td data-bbox="320 786 504 837">0 marks</td> <td data-bbox="504 786 1217 837">No response or nothing worthy of credit.</td> </tr> </tbody> </table> <p><b>Indicative content</b></p> <ul data-bbox="320 943 1217 1458" style="list-style-type: none"> <li>• <b>Focus groups</b> used to gather feedback on market trends, concepts etc from a specific demographic</li> <li>• Use of focus groups etc. to gather views on development models</li> <li>• <b>Surveys</b> allow designers to gather information through targeted questioning using closed and open responses.</li> <li>• Surveys are ideal for gathering information from a large range of potential customers and analysing for trends.</li> <li>• <b>Interviews</b> allow a designer to gather specific information from an individual that can be tailored to the specific interviewee.</li> <li>• <b>Secondary</b> data allows designers to use pre-gathered information available from reputable sources quickly for initial design development etc.</li> <li>• <b>Primary research</b> allows tailored research specific to the individual project.</li> <li>• By using social media analysis of current trends and habits.</li> </ul> <p><b>This list is not exhaustive. Accept any other valid responses.</b></p>	Marks	Description	3–4 marks	The response gives a detailed explanation of different market research methods and identifies their suitability to different stages of the design process. Some inaccuracies may be seen but will not detract from the quality of the answer.	1–2 marks	The response gives a generic explanation of market research with some reference to how it may be used in the design process.	0 marks	No response or nothing worthy of credit.	4 marks	AO4 2b
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0 marks	No response or nothing worthy of credit.											

Qu	Part	Marking Guidance	Total marks	AO
08		<p>State <b>four</b> safety precautions to be taken by the user when turning a wooden bowl on a wood lathe.</p> <p>1 mark for <b>each</b> of the following to a maximum of 4 marks.</p> <ul style="list-style-type: none"> <li>• Completion of appropriate safety training/use of instructions before use.</li> <li>• Appropriate face shield PPE worn at all times.</li> <li>• Entanglement risk</li> <li>• Checking that the bowl is secured to the appropriate faceplate/chuck before turning begins.</li> <li>• The use of effective wood work extraction.</li> <li>• Use of a rest to support the tool.</li> <li>• Positioning of the rest to reduce the gap from bowl.</li> <li>• The use of sharp tools etc to reduce the risk of snatching at tools.</li> <li>• Use of machine guards to reduce risk of contact with moving parts.</li> <li>• Check machine is running freely before starting motor.</li> <li>• Use of appropriate lighting for wood turning equipment.</li> <li>• Avoid use of laminated timber blocks.</li> <li>• Machine maintenance</li> </ul> <p>Note: Only accept <b>one</b> reference to PPE.  Only accept <b>one</b> reference to entanglement</p> <p><b>This list is not exhaustive.  Accept any other valid responses.</b></p>	4 marks	AO4 2a



Qu	Part	Marking Guidance	Total marks	AO										
09		<p>A turned metal component is to be manufactured on a manual lathe.</p> <p>Outline the information required to ensure it is accurately produced.</p> <table border="1" data-bbox="320 468 1214 1055"> <thead> <tr> <th data-bbox="320 468 504 517">Marks</th> <th data-bbox="504 468 1214 517">Description</th> </tr> </thead> <tbody> <tr> <td data-bbox="320 517 504 703">5–6 marks</td> <td data-bbox="504 517 1214 703">The response gives a detailed outline of specific, relevant information used to allow accurate production of a turned metal component. Responses within this range will refer to machine, tool and material settings.</td> </tr> <tr> <td data-bbox="320 703 504 853">3–4 marks</td> <td data-bbox="504 703 1214 853">The response gives a good outline of suitable information used to allow accurate production of a metal component. Responses within this range may refer to machine and material settings.</td> </tr> <tr> <td data-bbox="320 853 504 1003">1–2 marks</td> <td data-bbox="504 853 1214 1003">The response gives a basic outline of generic information required to produce a turned metal component. Responses within this range will make limited reference to specific settings.</td> </tr> <tr> <td data-bbox="320 1003 504 1055">0 marks</td> <td data-bbox="504 1003 1214 1055">No response or nothing worthy of credit.</td> </tr> </tbody> </table> <p><b>Indicative content</b></p> <ul style="list-style-type: none"> <li>• Reference to the type of metal required.</li> <li>• The stock form/size of material that the component is to be turned from.</li> <li>• The cutting speeds for each operation within the production must be specified to guarantee the surface finish required.</li> <li>• Dimensional drawing must be supplied to allow accurate production.</li> <li>• Dimensional tolerances must be given for quality control.</li> <li>• Use of go no-go gauge/templates to test for sizes.</li> <li>• The specific tooling to be used for each operation must be specified, eg if the end is to be knurled, thread tool for cutting the thread, parting tool to finish/cut the piece off.</li> <li>• Details of lubrication, any reference to appropriate lubricant would be credited.</li> <li>• Feed rates must be specified.</li> <li>• Flow diagram to show sequence of operations.</li> <li>• Machine maintenance records</li> </ul> <p>Reference to safe working practices and PPE should not be credited as they are not directly related to accuracy.</p> <p><b>This list is not exhaustive. Accept any other valid responses.</b></p>	Marks	Description	5–6 marks	The response gives a detailed outline of specific, relevant information used to allow accurate production of a turned metal component. Responses within this range will refer to machine, tool and material settings.	3–4 marks	The response gives a good outline of suitable information used to allow accurate production of a metal component. Responses within this range may refer to machine and material settings.	1–2 marks	The response gives a basic outline of generic information required to produce a turned metal component. Responses within this range will make limited reference to specific settings.	0 marks	No response or nothing worthy of credit.	6 marks	AO4 2b
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10		<p>A bracelet is made from resin where powder, liquid and pigment are mixed in the ratio of 2.5 : 4 : 1</p> <p>The bracelet uses 28 grams less powder than liquid.</p> <p>Calculate the total mass of the bracelet in grams.</p> <p>Show your working.</p> <table border="1" data-bbox="320 645 1214 2056"> <tr> <td data-bbox="320 645 643 1167">Calculate how many parts of the ratio 28 grams makes up</td> <td data-bbox="643 645 1062 1167">                     Difference in number of parts between liquid and powder:  <math>4 - 2.5 = 1.5</math>  <b>or</b>  <math>28 \text{ grams} = 1.5 \text{ parts}</math>  <b>or</b>  <math>4 + 2.5 + 1 = 7.5</math> </td> <td data-bbox="1062 645 1214 1167">1 mark</td> </tr> <tr> <td data-bbox="320 1167 643 1585">Calculate the mass of one part</td> <td data-bbox="643 1167 1062 1585"> <math>28 \text{ grams} \times \frac{2}{3}</math>  <math>= [18.6, 18.7] \text{ grams}</math>  <b>or</b>  <math>\frac{7.5}{1.5} \times 28</math> </td> <td data-bbox="1062 1167 1214 1585">1 mark</td> </tr> <tr> <td data-bbox="320 1585 643 1906">Multiply by the number of parts</td> <td data-bbox="643 1585 1062 1906"> <math>[18.66 \times (2.5 + 4 + 1)]</math>  <math>= [139.5, 140.25] \text{ grams}</math> </td> <td data-bbox="1062 1585 1214 1906">1 mark</td> </tr> <tr> <td data-bbox="320 1906 643 2056">Where no working has been shown but final answer is accurate</td> <td data-bbox="643 1906 1062 2056">[139.5, 140.25] grams</td> <td data-bbox="1062 1906 1214 2056">3 marks</td> </tr> </table>	Calculate how many parts of the ratio 28 grams makes up	Difference in number of parts between liquid and powder: $4 - 2.5 = 1.5$ <b>or</b> $28 \text{ grams} = 1.5 \text{ parts}$ <b>or</b> $4 + 2.5 + 1 = 7.5$	1 mark	Calculate the mass of one part	$28 \text{ grams} \times \frac{2}{3}$ $= [18.6, 18.7] \text{ grams}$ <b>or</b> $\frac{7.5}{1.5} \times 28$	1 mark	Multiply by the number of parts	$[18.66 \times (2.5 + 4 + 1)]$ $= [139.5, 140.25] \text{ grams}$	1 mark	Where no working has been shown but final answer is accurate	[139.5, 140.25] grams	3 marks	3 marks	AO4 2c
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11		<p><b>Figures 9, 10 and 11</b> show <b>three</b> coffee cups.</p> <p>Analyse and evaluate the <b>environmental impact</b> of all <b>three</b> cups.</p> <p>In your answer you should refer to:</p> <ul style="list-style-type: none"> <li>• raw materials</li> <li>• product manufacture</li> <li>• disposal.</li> </ul> <table border="1" data-bbox="320 678 1214 1534"> <thead> <tr> <th data-bbox="320 678 512 730">Marks</th> <th data-bbox="512 678 1214 730">Description</th> </tr> </thead> <tbody> <tr> <td data-bbox="320 730 512 1014">9–12 marks</td> <td data-bbox="512 730 1214 1014">The response provides detailed analysis and evaluation of the environmental impact of all three coffee cups, referring with technical detail to multiple stages of the product life cycle, while using the full range of tabulated information. There may be some minor irrelevant points or lack of clarity in some points but this will not detract from the overall quality of the response.</td> </tr> <tr> <td data-bbox="320 1014 512 1332">5–8 marks</td> <td data-bbox="512 1014 1214 1332">The response provides a good analysis and evaluation of the coffee cups mainly focussing on the environmental impact. Most of the tabulated information has been utilised to form analytical statements showing some technical detail beyond the information provided. At the lower end of the mark band there may be limited expansion on some of the information. The majority of points will be relevant.</td> </tr> <tr> <td data-bbox="320 1332 512 1485">1–4 marks</td> <td data-bbox="512 1332 1214 1485">The coffee cups are compared in basic terms with limited expansion upon the information provided. At the lower end of the mark band points will be restricted to comparing given information.</td> </tr> <tr> <td data-bbox="320 1485 512 1534">0 marks</td> <td data-bbox="512 1485 1214 1534">No response or nothing worthy of credit.</td> </tr> </tbody> </table> <p><b>Indicative content</b></p> <p><b>Raw material extraction</b></p> <ul style="list-style-type: none"> <li>• <b>Figure 9</b> cup and sleeve produced from wood pulp, ideally from FSC fibres/managed forests preventing deforestation.</li> <li>• <b>Figure 9</b> lid, <b>Figure 10</b> cup, lid and sleeve and <b>Figure 11</b> lid are produced from oil which is finite resource impacting on environment.</li> <li>• Extraction/mining of ores required for production of stainless steel and the impact of these re: habitat loss, deforestation if mines are open-cast.</li> </ul>	Marks	Description	9–12 marks	The response provides detailed analysis and evaluation of the environmental impact of all three coffee cups, referring with technical detail to multiple stages of the product life cycle, while using the full range of tabulated information. There may be some minor irrelevant points or lack of clarity in some points but this will not detract from the overall quality of the response.	5–8 marks	The response provides a good analysis and evaluation of the coffee cups mainly focussing on the environmental impact. Most of the tabulated information has been utilised to form analytical statements showing some technical detail beyond the information provided. At the lower end of the mark band there may be limited expansion on some of the information. The majority of points will be relevant.	1–4 marks	The coffee cups are compared in basic terms with limited expansion upon the information provided. At the lower end of the mark band points will be restricted to comparing given information.	0 marks	No response or nothing worthy of credit.	12 marks	AO3 1a AO3 1b
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		<p><b>Production</b></p> <ul style="list-style-type: none"> <li>• <b>Figure 9</b> uses water and energy in the production of the laminated sheet, the addition of a polymer film requires adhesion adding energy and complexity to the process.</li> <li>• The die cutting process produces waste which can be pulped and reused or incinerated and used to power further production.</li> <li>• <b>Figure 9</b> uses heat in the lid forming process (vacuum forming), but HIPS has a relatively low melting point reducing energy use.</li> <li>• The forming of the lid for <b>Figure 9</b> creates waste which needs granulating and extruding into further sheets for further vacuum forming.</li> <li>• <b>Figure 10</b> requires injection moulding for the cup component requiring heat and electrical energy but produces waste that can be reused for further lids.</li> <li>• As Silicone is a not a thermoplastic elastomer the forming processes produce waste that can't be re-melted and must be disposed of.</li> <li>• <b>Figure 11</b> is formed through press forming using electrical energy.</li> <li>• <b>Figure 11</b> lid uses two materials that are clipped together requiring no adhesive.</li> <li>• Clear thermoplastic lids require 'virgin' polymer to keep glass like transparency.</li> </ul> <p><b>Use/disposal</b></p> <ul style="list-style-type: none"> <li>• <b>Figure 9</b> is a single use product which is often disposed of with no regard for recycling.</li> <li>• If recycled the laminate layer on the card makes separation of materials difficult.</li> <li>• <b>Figures 10 and 11</b> both require the user to remember to take them with them.</li> <li>• If forgotten then the purchase of the cup is an unnecessary waste of energy and materials.</li> <li>• <b>Figure 10</b> is an insulator and will not burn hands when used, although hot drinks are not kept hot for long.</li> <li>• <b>Figure 11</b> is a conductor and if a single layer will heat up and may burn user.</li> <li>• <b>Figure 10</b> is produced from two materials that can be easily separated but silicone is not easily recycled and may not be removed by user when recycling.</li> <li>• <b>Figure 11</b> requires lid to be separated for recycling to take place.</li> <li>• When disposed of in landfill polymers have long degradation times and will impact on the environment.</li> </ul> <p><b>This list is not exhaustive. Accept any other valid responses.</b></p>		
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Qu	Part	Marking Guidance	Total marks	AO
12		<p>Describe <b>three</b> key characteristics of an effective design specification.</p> <p><b>Indicative content</b></p> <p>1 mark for <b>each</b> relevant point to a maximum of 3 marks.</p> <ul style="list-style-type: none"> <li>• <b>Objective:</b> A document that can be <b>easily interpreted</b> by all without subjectivity.</li> <li>• <b>Formed from research:</b> A document which consists of points key characteristics gathered from research.</li> <li>• Gives a <b>clear list of criteria for evaluation.</b></li> <li>• <b>A document that is flexible</b>/a working document that can be updated/reflected upon during the whole design process.</li> <li>• A document that <b>includes measurable criteria</b> to assess design suitability.</li> <li>• A document that <b>addresses client needs</b></li> <li>• <b>Justifies reason</b> for points included on the specification</li> <li>• <b>Inclusion of specific quantitative data</b></li> <li>• <b>Comprehensive</b> list of criteria</li> </ul> <p><b>This list is not exhaustive. Accept any other valid responses.</b></p>	3 marks	AO4 2b

Qu	Part	Marking Guidance	Total marks	AO									
13	1	<p><b>Figure 12</b> shows a packaging net.</p> <p>The digital printing process means areas <b>A</b>, <b>B</b>, <b>C</b> and <b>D</b> can have a range of different designs applied independently.</p> <p><b>Area A: Five</b> different designs  <b>Area B: Seven</b> different designs  <b>Area C: Five</b> different designs  <b>Area D: Two</b> different designs</p> <p>Calculate the number of different design combinations possible.</p> <p>Show your working.</p> <table border="1" data-bbox="320 853 1217 1335"> <tbody> <tr> <td data-bbox="320 853 643 1037">Multiplication of different print designs</td> <td data-bbox="646 853 1061 1037"><b>Area A × Area B × Area C × Area D</b></td> <td data-bbox="1064 853 1217 1037">1 mark</td> </tr> <tr> <td data-bbox="320 1041 643 1184">Correct Answer</td> <td data-bbox="646 1041 1061 1184">5 × 7 × 5 × 2 350</td> <td data-bbox="1064 1041 1217 1184">1 mark</td> </tr> <tr> <td data-bbox="320 1189 643 1335">Correct answer without working shown.</td> <td data-bbox="646 1189 1061 1335">350</td> <td data-bbox="1064 1189 1217 1335">2 marks</td> </tr> </tbody> </table>	Multiplication of different print designs	<b>Area A × Area B × Area C × Area D</b>	1 mark	Correct Answer	5 × 7 × 5 × 2 350	1 mark	Correct answer without working shown.	350	2 marks	2 marks	AO4 2c
Multiplication of different print designs	<b>Area A × Area B × Area C × Area D</b>	1 mark											
Correct Answer	5 × 7 × 5 × 2 350	1 mark											
Correct answer without working shown.	350	2 marks											

Qu	Part	Marking Guidance	Total marks	AO									
13	2	<p>A customer is collecting copies of each different package design and needs three more to complete the set.</p> <p>Assume the design of <b>Area B</b> is known.</p> <p>Calculate the probability that the package they receive will be one of the specific design combinations they require.</p> <p>Show your working.</p> <table border="1" data-bbox="320 678 1217 1973"> <tbody> <tr> <td data-bbox="320 678 644 1263">Calculate number of combinations possible if B is fixed</td> <td data-bbox="644 678 1062 1263"> <math>5 \times 5 \times 2</math>                      Or  <math>\frac{1}{50}</math>                      or  <math>\frac{7}{350}</math>                      or                      2%                 </td> <td data-bbox="1062 678 1217 1263">1 mark</td> </tr> <tr> <td data-bbox="320 1263 644 1619">Convert to a probability fraction and multiply by number of alternatives</td> <td data-bbox="644 1263 1062 1619"> <math>\frac{3}{50}</math>                      or                      6%                      or                      0.06                 </td> <td data-bbox="1062 1263 1217 1619">1 mark</td> </tr> <tr> <td data-bbox="320 1619 644 1973">Correct answer without working shown.</td> <td data-bbox="644 1619 1062 1973"> <math>\frac{3}{50}</math>                      or                      6%                      or                      0.06                 </td> <td data-bbox="1062 1619 1217 1973">2 marks</td> </tr> </tbody> </table>	Calculate number of combinations possible if B is fixed	$5 \times 5 \times 2$ Or $\frac{1}{50}$ or $\frac{7}{350}$ or 2%	1 mark	Convert to a probability fraction and multiply by number of alternatives	$\frac{3}{50}$ or 6% or 0.06	1 mark	Correct answer without working shown.	$\frac{3}{50}$ or 6% or 0.06	2 marks	2 marks	AO4 2c
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Qu	Part	Marking Guidance	Total marks	AO
14		<p>Name <b>two</b> specific measuring devices that can be used to ensure components conform to acceptable tolerances.</p> <p>1 mark for <b>each</b> appropriate device to a maximum of 2 marks.</p> <p>Appropriate devices:</p> <ul style="list-style-type: none"> <li>• go no-go gauge</li> <li>• vernier caliper</li> <li>• micrometer</li> <li>• probe/laser scanning</li> <li>• Coordinate Measuring Machine (CMM)</li> <li>• steel rule/measuring tape</li> <li>• Specific NDT (Non-Destructive Testing)</li> <li>• weighing scales</li> </ul> <p><b>This list is not exhaustive. Accept any other valid responses.</b></p>	2 marks	AO4 2a



Qu	Part	Marking Guidance	Total marks	AO
15		<p><b>Figure 13</b> shows a carbonated drinks bottle.</p> <p>Identify and explain <b>three</b> specific dimensional quality control checks needed to ensure the carbonated drinks bottle can be filled and sealed correctly.</p> <p>1 mark for <b>each</b> specific dimension to be checked up to a maximum of 3 marks.</p> <p>1 mark for <b>each</b> explanation of the importance of that dimension.</p> <p><b>Example responses</b></p> <ul style="list-style-type: none"> <li>• The <b>volume of the bottle</b> must be checked to allow the <b>designated volume for that container</b> with appropriate gap below lid to allow for gas expansion.</li> <li>• The ability of the bottle to <b>stand vertically unaided</b> to prevent falling on filling line etc.</li> <li>• The <b>neck diameter</b> must be checked to make sure the <b>screw on lid will fit and a seal can be produced to prevent CO<sub>2</sub> leakage</b>.</li> <li>• The <b>thickness of the polymer</b> must be checked to ensure the <b>bottle can withstand the pressures associated with carbonated drinks</b> without fracture.</li> <li>• The <b>height of the bottle</b> must be checked to <b>ensure that it fits on the production line</b> (or is the correct height for the filling nozzle on the production line).</li> <li>• The <b>length/depth of the screw</b> will need to be checked to ensure that there is enough length/depth for the bottle top to fit and seal correctly.</li> <li>• The <b>pitch of the screw thread</b> must be checked to match the screw top lid to be attached.</li> </ul> <p><b>This list is not exhaustive. Accept any other valid responses.</b></p>	6 marks	AO4 2c

Qu	Part	Marking Guidance	Total marks	AO
16	1	<p>Define the terms ‘ergonomics’ and ‘anthropometrics’.</p> <p>1 mark for the definition of ergonomic data:</p> <ul style="list-style-type: none"> <li>• data that considers the interaction of humans with products and the environment.</li> </ul> <p>1 mark for the definition of anthropometric data:</p> <ul style="list-style-type: none"> <li>• measurement of human sizes.</li> </ul>	2 marks	AO4 2a

Qu	Part	Marking Guidance	Total marks	AO
16	2	<p>State <b>one</b> way that a product with good ergonomics can benefit the product user.</p> <p>1 mark for an example of how a user benefits from good ergonomic products:</p> <ul style="list-style-type: none"> <li>• lack of discomfort during use</li> <li>• ability to use for long period of time</li> <li>• safe and accurate use with limited if any instruction</li> <li>• efficient use of movement during use.</li> </ul> <p><b>This list is not exhaustive. Accept any other valid responses.</b></p>	1 mark	AO4 2a

Qu	Part	Marking Guidance	Total marks	AO										
17		<p><b>Figures 14 and 15</b> show two products designed by Dieter Rams.</p> <p>Describe how the products shown in <b>Figures 14 and 15</b> conform to the principles of modernist design.</p> <table border="1" data-bbox="320 506 1217 958"> <thead> <tr> <th data-bbox="320 506 504 555">Marks</th> <th data-bbox="504 506 1217 555">Description</th> </tr> </thead> <tbody> <tr> <td data-bbox="320 555 504 674">3 marks</td> <td data-bbox="504 555 1217 674">The response gives a detailed description of how the two products conform to specific modernist design principles</td> </tr> <tr> <td data-bbox="320 674 504 792">2 marks</td> <td data-bbox="504 674 1217 792">The response gives a good description of modernist design principles with some attempt to link to the products.</td> </tr> <tr> <td data-bbox="320 792 504 911">1 mark</td> <td data-bbox="504 792 1217 911">The response identifies vague characteristics of modernism with limited attempt to link to the products.</td> </tr> <tr> <td data-bbox="320 911 504 958">0 marks</td> <td data-bbox="504 911 1217 958">No response or nothing worthy of credit.</td> </tr> </tbody> </table> <p><b>Indicative content:</b></p> <ul data-bbox="320 1099 1217 1350" style="list-style-type: none"> <li>• the designs follow the statement of form follows function regarding their minimalist design ability to use for long period of time</li> <li>• both designs use very minimalist colour palettes with the focus on grey/silver etc</li> <li>• both designs use simple geometric forms in their construction</li> <li>• both designs used modern materials and manufacturing techniques.</li> </ul> <p><b>This list is not exhaustive. Accept any other valid responses.</b></p>	Marks	Description	3 marks	The response gives a detailed description of how the two products conform to specific modernist design principles	2 marks	The response gives a good description of modernist design principles with some attempt to link to the products.	1 mark	The response identifies vague characteristics of modernism with limited attempt to link to the products.	0 marks	No response or nothing worthy of credit.	3 marks	AO4 2a
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