



A-level
**DESIGN AND TECHNOLOGY:
PRODUCT DESIGN**
7552/1

Paper 1 Technical Principles

Mark scheme

June 2021

Version: 1.0 Final



2 1 6 A 7 5 5 2 / 1 / 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.

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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.



[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.

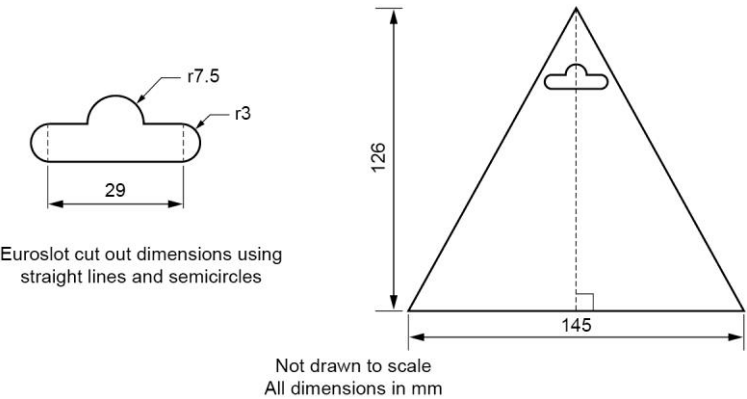
Qu	Part	Marking Guidance	Total marks	AO								
01		<p>Identify each of the following Control of Substances Hazardous to Health (COSHH) symbols.</p> <table border="1" data-bbox="320 450 1219 1182"> <thead> <tr> <th data-bbox="325 456 770 483">COSHH Symbol</th> <th data-bbox="775 456 1214 483">Description</th> </tr> </thead> <tbody> <tr> <td data-bbox="325 490 770 714">  </td> <td data-bbox="775 490 1214 714">Hazardous to the environment</td> </tr> <tr> <td data-bbox="325 721 770 945">  </td> <td data-bbox="775 721 1214 945">Health Hazard/Carcinogenic</td> </tr> <tr> <td data-bbox="325 952 770 1176">  </td> <td data-bbox="775 952 1214 1176">Corrosive</td> </tr> </tbody> </table> <p data-bbox="320 1218 868 1249">One mark per symbol correctly identified.</p>	COSHH Symbol	Description		Hazardous to the environment		Health Hazard/Carcinogenic		Corrosive	3 marks	AO4 1a
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02		<p>Describe the process of die cutting.</p> <table border="1" data-bbox="320 405 1214 837"> <thead> <tr> <th data-bbox="320 405 475 461">Marks</th> <th data-bbox="475 405 1214 461">Description</th> </tr> </thead> <tbody> <tr> <td data-bbox="320 461 475 577">5–6 marks</td> <td data-bbox="475 461 1214 577">The response covers in detail the required stages in a logical sequence to produce a successful die cut product.</td> </tr> <tr> <td data-bbox="320 577 475 696">3–4 marks</td> <td data-bbox="475 577 1214 696">The response recalls with some description of most of the main stages of the process which if followed would achieve a successful die cut product.</td> </tr> <tr> <td data-bbox="320 696 475 784">1–2 marks</td> <td data-bbox="475 696 1214 784">The response recalls the basic stages of die cutting.</td> </tr> <tr> <td data-bbox="320 784 475 837">0 marks</td> <td data-bbox="475 784 1214 837">No response or nothing worthy of credit.</td> </tr> </tbody> </table> <p>Indicative content</p> <p>Die production</p> <ul data-bbox="320 981 1214 1182" style="list-style-type: none"> • A thin steel cutter blade is folded and shaped into the desired profile or shape. • Creasing rules and perforations can be incorporated into the die depending on the required output. • These blades are mounted into a substrate board/cylinder which maintains the shape and alignment of the die. <p>Mounting die in machine</p> <ul data-bbox="320 1256 1214 1357" style="list-style-type: none"> • The die is mounted into a pressing machine that may be manual or hydraulic. • The die can either be flat or cylindrical. <p>Feed card into machine</p> <ul data-bbox="320 1431 1214 1496" style="list-style-type: none"> • Card blanks are fed into the press either in batches or continuously. <p>Card secured in place</p> <ul data-bbox="320 1570 1214 1635" style="list-style-type: none"> • The substrate to be cut is located in the machine, often using locator guides to ensure the correct alignment. <p>Pressure applied to card</p> <ul data-bbox="320 1709 1214 1774" style="list-style-type: none"> • The die is forced through the material and the waste material and die cut pattern is removed. <p>Pressure removed and card ejected</p> <ul data-bbox="320 1848 1214 1946" style="list-style-type: none"> • A soft rubber support surrounds the die. This is compressed when the die is used and ejects the cut material when the force is removed. <p>This list is not exhaustive. Accept any other valid responses.</p>	Marks	Description	5–6 marks	The response covers in detail the required stages in a logical sequence to produce a successful die cut product.	3–4 marks	The response recalls with some description of most of the main stages of the process which if followed would achieve a successful die cut product.	1–2 marks	The response recalls the basic stages of die cutting.	0 marks	No response or nothing worthy of credit.	6 marks	AO4 1a
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Qu	Part	Marking Guidance	Total marks	AO																					
03		<p>Figure 1 and Figure 2 show freestanding signage.</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <p>Figure 1</p>  </div> <div style="text-align: center;"> <p>Figure 2</p>  </div> </div> <table border="1" style="margin-top: 20px; width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;">Figure 1</th> <th style="text-align: center;">Figure 2</th> </tr> </thead> <tbody> <tr> <td>Sign type</td> <td style="text-align: center;">Safety sign</td> <td style="text-align: center;">Novelty sign</td> </tr> <tr> <td>Method of manufacture</td> <td style="text-align: center;">Injection moulded</td> <td style="text-align: center;">Vacuum formed</td> </tr> <tr> <td>Material</td> <td style="text-align: center;">High Density Polyethylene (HDPE)</td> <td style="text-align: center;">High Impact Polystyrene (HIPS)</td> </tr> <tr> <td>Style of hinge</td> <td style="text-align: center;">Integrated hinge</td> <td style="text-align: center;">Riveted hinge</td> </tr> </tbody> </table> <p style="margin-top: 20px;">Compare and evaluate the suitability of the manufacturing processes used for each sign.</p> <table border="1" style="margin-top: 20px; width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;">Marks</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td style="text-align: center; vertical-align: top;">5–6 marks</td> <td>The response shows detailed analysis and compares the suitability of each manufacturing process for the signage shown. The response evaluates how appropriate the manufacturing process is based on the information provided with reference to complexity of the design and lifespan of the product.</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">3–4 marks</td> <td>The response shows good analysis of the suitability of each manufacturing process for the signage shown. Response provides some evaluation of how appropriate the manufacturing process is and may reference the complexity of the design and lifespan of the product.</td> </tr> </tbody> </table>		Figure 1	Figure 2	Sign type	Safety sign	Novelty sign	Method of manufacture	Injection moulded	Vacuum formed	Material	High Density Polyethylene (HDPE)	High Impact Polystyrene (HIPS)	Style of hinge	Integrated hinge	Riveted hinge	Marks	Description	5–6 marks	The response shows detailed analysis and compares the suitability of each manufacturing process for the signage shown. The response evaluates how appropriate the manufacturing process is based on the information provided with reference to complexity of the design and lifespan of the product.	3–4 marks	The response shows good analysis of the suitability of each manufacturing process for the signage shown. Response provides some evaluation of how appropriate the manufacturing process is and may reference the complexity of the design and lifespan of the product.	6 marks	AO3 2a AO3 2b
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1–2 marks	Basic evaluation of the suitability of the manufacturing processes but response tends to be descriptive rather than evaluative and may focus on only one of the signs.		
0 marks	No response or nothing worthy of credit.		
<p>Indicative content</p>			
<p>Injection moulded sign</p>			
<ul style="list-style-type: none"> • Injection moulding is appropriate due to the large market for the safety signage. • Injection moulding has significant set up costs only viable due to the large market for the sign. • Injection moulding produces a solid component that can have features such as handles and hinges incorporated into the design. • The sign is designed to have an extended lifespan and will be regularly used. The injection moulding process provides a high-quality outcome that will have a good level of durability. • The integrated hinge provides a strong and durable solution that can be easily incorporated into the injection mould, removing the need for an additional fixing. 			
<p>Vacuum formed sign</p>			
<ul style="list-style-type: none"> • Vacuum forming can successfully create simple, non-complex forms such as the novelty sign. • The depth of the sign is suitable for vacuum forming and an aperture for the handle could be easily incorporated in to the mould. • The tooling for vacuum forming is less expensive than injection moulding and as such the seasonal nature of the product is financially viable. • The vacuum formed sign is designed for novelty use, such as a seasonal event like Halloween. As such, the suitability of vacuum forming as a batch production process is appropriate. • The riveted fixing provides limited movement and the thin structure of the vacuum forming does not have enough strength and is likely to crack or split at the location of the fixing. 			
<p>This list is not exhaustive. Accept any other valid responses.</p>			

Qu	Part	Marking Guidance	Total marks	AO
04		<p>Give three reasons why a product may have an anodised finish.</p> <p>One mark for each appropriate reason.</p> <p>Indicative content</p> <ul style="list-style-type: none"> • Anodising can increase the resistance to corrosion. • Anodising can be used to add a pigment, colour, or decorative surface finish. • Anodising increases the hardness of the aluminium product's surface. • Anodising increases the toughness of the aluminium product's surface. • Anodising can increase the resistance to wear when in contact with other materials. <p>This list is not exhaustive. Accept any other valid responses.</p>	3 marks	AO4 1b

Qu	Part	Marking Guidance	Total marks	AO
05		<p>Calculate the area of the face shown in the packaging in Figure 3.</p> <p style="text-align: center;">Figure 3</p>  <p style="text-align: center;">Not drawn to scale All dimensions in mm</p> <p>Calculating area of the triangle $\frac{1}{2}$ base \times height 1 mark (M1)</p> $\frac{1}{2} 145 \times 126$ $= 9135$ <p>Calculating the area of the euroslot components Area of rectangle 1 mark (M1)</p> $29 \times 3 \times 2$ $= 174$ <p>Area of circle (πr^2) 1 mark (M1)</p> $= \pi 3^2$ $= [28.26, 28.28]$ <p>Area of semicircle ($\frac{\pi r^2}{2}$)</p> $= \frac{\pi 7.5^2}{2}$ $= [88.31, 88.37]$	6 marks	AO4 1c

		<p>Total area of euroslot</p>	<p>their 174 + their [28.26, 28.28] + their [88.31, 88.37]</p> <p>or</p> <p>[290.57, 290.65]</p>	<p>1 mark (A1)</p>		
		<p>Calculating the total surface area</p>	<p>9135 – their [290.57, 290.65]</p> <p>= [8844.30, 8880.43] mm²</p>	<p>1 mark (M1) 1 mark (A1)</p>		
		<p>Calculating the total surface area Where no working has been shown but final answer is accurate</p>	<p>= [8844.30, 8880.43] mm²</p>	<p>6 marks</p>		







Qu	Part	Marking Guidance	Total marks	AO										
06		<p>Discuss the advantages and disadvantages of buying a bespoke item of furniture for the home.</p> <table border="1"> <thead> <tr> <th>Marks</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>5–6 marks</td> <td>The response clearly shows detailed analysis of both the advantages and disadvantages of buying bespoke furniture. The response evaluates the key factors associated with bespoke furniture and how these may affect the consumer.</td> </tr> <tr> <td>3-4 marks</td> <td>The response shows good analysis of the advantages and disadvantages of buying bespoke furniture. The response provides some evaluation of the key factors associated with bespoke furniture and how these may affect the consumer.</td> </tr> <tr> <td>1–2 marks</td> <td>Basic discussion of the advantages and disadvantages of buying bespoke furniture but response tends to be descriptive or may appear as a simple list.</td> </tr> <tr> <td>0 marks</td> <td>No response or nothing worthy of credit.</td> </tr> </tbody> </table> <p>Indicative content</p> <p>Advantages</p> <ul style="list-style-type: none"> Bespoke furniture will be designed and manufactured to a particular size which may have been measured by an onsite visit. This in turn means that that furniture when produced would be a perfect fit for the location. Bespoke furniture allows the client to communicate their wishes to the manufacturer, allowing for the selection of colours to match existing décor or selection of materials to match existing furniture. The purchase of bespoke furniture allows the customer to select a particular designer or manufacturer based on their reputation or existing portfolio of work. Bespoke furniture can be designed to fulfil all of the aesthetic and functional needs of the client. <p>Disadvantages</p> <ul style="list-style-type: none"> Bespoke furniture will be more expensive than an off-the-shelf equivalent product due to the cost of the craftsman, the lack of cost-saving mass production techniques and the less efficient use of material associated with having to create custom sections or forms. The manufacture of bespoke furniture is a great deal more time consuming than selecting an off-the-shelf piece for subsequent delivery. This means that the customer’s order would be subject to an extended lead time. 	Marks	Description	5–6 marks	The response clearly shows detailed analysis of both the advantages and disadvantages of buying bespoke furniture. The response evaluates the key factors associated with bespoke furniture and how these may affect the consumer.	3-4 marks	The response shows good analysis of the advantages and disadvantages of buying bespoke furniture. The response provides some evaluation of the key factors associated with bespoke furniture and how these may affect the consumer.	1–2 marks	Basic discussion of the advantages and disadvantages of buying bespoke furniture but response tends to be descriptive or may appear as a simple list.	0 marks	No response or nothing worthy of credit.	6 marks	AO3 2a AO3 2b
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	<ul style="list-style-type: none">• Bespoke furniture is less likely to make use of knock down fittings or bought in components.• If the furniture becomes damaged or a component needs replacing, it is unlikely for the customer to be able to easily access the necessary spares. <p>This list is not exhaustive. Accept any other valid responses.</p>		
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		<p>Calculating the number that could be produced before IM becomes cheaper Error made in money units.</p> <p>Or alternative method based on inequalities.</p> <p>Total costs</p> <p>Setting up inequality</p> <p>Solving inequality</p> <p>Calculating the number that could be produced before IM becomes cheaper</p> <p>Calculating the number that could be produced before IM becomes cheaper Where no working has been shown but final answer is accurate</p> <p>Calculating the number that could be produced before IM becomes cheaper Error made in money units</p> <p>Or alternative method where candidates have attempted to estimate the numbers.</p>	<p>296 or 297</p> <p>3D Print = $30x$ (pence)</p> <p>Injection Mould = $800\,000 + 3x$ (pence)</p> <p>800 000 + $0.03x > 30x$</p> <p>$x < \frac{800\,000}{27}$</p> <p>$x < 29629.62$</p> <p>= 29 629 units</p> <p>= 29 629 units</p> <p>296 or 297</p>	<p>2 marks</p> <p>1 mark (M1)</p> <p>1 mark (M1)</p> <p>1 mark (M1)</p> <p>1 mark (A1)</p> <p>4 marks</p> <p>2 marks</p>		
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	<p>A trial for a value of the number of units of both types correctly evaluated</p>	<p><u>eg 1000 units</u></p> <p>$1000 \times 0.3 = \text{£}300$</p> <p>$1000 \times 0.03 + 8000 = \text{£}8300$</p>	<p>1 mark (M1)</p>		
	<p>A better trial, ie closer to the correct answer than the first</p>	<p><u>eg 50 000 units</u></p> <p>$50\ 000 \times 0.3 = \text{£}15\ 000$</p> <p>$50\ 000 \times 0.03 + 8000 = \text{£}9500$</p>	<p>1 mark (M1)</p>		
	<p>A third trial, ‘better’ than the first two</p>	<p><u>eg 30 000 units</u></p> <p>$30\ 000 \times 0.3 = \text{£}9000$</p> <p>$30\ 000 \times 0.03 + 8000 = \text{£}8900$</p>	<p>1 mark (M1)</p>		
	<p>Calculating the number that could be produced before IM becomes cheaper</p>	<p>= 29 629 units</p>	<p>1 mark (A1)</p>		
	<p>Calculating the number that could be produced before IM becomes cheaper Where no working has been shown but final answer is accurate</p>	<p>= 29 629 units</p>	<p>4 marks</p>		
	<p>Calculating the number that could be produced before IM becomes cheaper Error made in money units</p>	<p>296 or 297</p>	<p>2 marks</p>		

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08		<p>Explain why injection moulding is not a suitable manufacturing method for large products.</p> <table border="1" data-bbox="320 439 1214 943"> <thead> <tr> <th data-bbox="320 439 461 495">Marks</th> <th data-bbox="461 439 1214 495">Description</th> </tr> </thead> <tbody> <tr> <td data-bbox="320 495 461 651">5–6 marks</td> <td data-bbox="461 495 1214 651">The response shows a detailed understanding of the limitations of scale when injection moulding. The response may refer to the limitations of the machinery, the mould and the moulding.</td> </tr> <tr> <td data-bbox="320 651 461 801">3–4 marks</td> <td data-bbox="461 651 1214 801">The response demonstrates a good understanding of the limitations of scale when injection moulding. The response may refer to some factors that limit the suitability of the process.</td> </tr> <tr> <td data-bbox="320 801 461 891">1–2 marks</td> <td data-bbox="461 801 1214 891">The response offers a basic understanding of limitations of scale when injection moulding.</td> </tr> <tr> <td data-bbox="320 891 461 943">0 marks</td> <td data-bbox="461 891 1214 943">No response or nothing worthy of credit.</td> </tr> </tbody> </table> <p>Indicative content</p> <ul data-bbox="320 1048 1214 1529" style="list-style-type: none"> • The weight and scale of the mould can make large tooling prohibitive to handle when being manufactured. • The physical size of the injection moulding machine limits the maximum size of the mould available. • The costs associated with the production of a large injection mould would be hugely prohibitive, including the material of the mould, the injection moulding machine, the industrial space to locate the machine itself. • The polymer cooling too quickly means the cavities of the mould may not fill completely. • A large mould with thick walls increases problems associated with shrinkage. • Injection moulding may prove challenging to design a successful large moulding with a thin wall thickness. <p>This list is not exhaustive. Accept any other valid responses.</p>	Marks	Description	5–6 marks	The response shows a detailed understanding of the limitations of scale when injection moulding. The response may refer to the limitations of the machinery, the mould and the moulding.	3–4 marks	The response demonstrates a good understanding of the limitations of scale when injection moulding. The response may refer to some factors that limit the suitability of the process.	1–2 marks	The response offers a basic understanding of limitations of scale when injection moulding.	0 marks	No response or nothing worthy of credit.	6 marks	AO4 1b
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09		<p>Name the following metal stock forms.</p> <table border="1" data-bbox="320 405 1217 1021"> <thead> <tr> <th data-bbox="320 405 770 443">Stock Form</th> <th data-bbox="770 405 1217 443">Profile</th> </tr> </thead> <tbody> <tr> <td data-bbox="320 443 770 734">  </td> <td data-bbox="770 443 1217 734"> <p>Angle (Accept Angleline or Lsection)</p> </td> </tr> <tr> <td data-bbox="320 734 770 1021">  </td> <td data-bbox="770 734 1217 1021"> <p>Tee</p> </td> </tr> </tbody> </table> <p>One mark per correctly named stock metal profile.</p>	Stock Form	Profile		<p>Angle (Accept Angleline or Lsection)</p>		<p>Tee</p>	2 marks	AO4 1a
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	<p>Tee</p>									

Qu	Part	Marking Guidance	Total marks	AO										
10		<p data-bbox="320 338 1217 439">Compare and evaluate the suitability of the materials used to manufacture the dishwasher detergent packaging shown in Figure 4 and Figure 5.</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <p data-bbox="491 510 600 539">Figure 4</p>  <p data-bbox="491 860 600 889">Lactide</p> </div> <div style="text-align: center;"> <p data-bbox="938 510 1046 539">Figure 5</p>  <p data-bbox="842 860 1142 927">Individual tablet with foil-based packaging</p> </div> </div> <table border="1" data-bbox="320 999 1222 1496" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th data-bbox="320 999 464 1048">Marks</th> <th data-bbox="464 999 1222 1048">Description</th> </tr> </thead> <tbody> <tr> <td data-bbox="320 1048 464 1205">5–6 marks</td> <td data-bbox="464 1048 1222 1205">The response includes detailed analysis and evaluation, comparing the two packaging methods with reference to factors such as transport, ease of use, and environmental impact.</td> </tr> <tr> <td data-bbox="320 1205 464 1361">3–4 marks</td> <td data-bbox="464 1205 1222 1361">The response includes good analysis and evaluation of both packaging methods and draws some comparison with reference to factors such as transport, ease of use, and environmental impact.</td> </tr> <tr> <td data-bbox="320 1361 464 1447">1–2 marks</td> <td data-bbox="464 1361 1222 1447">The response includes basic analysis and tends to be descriptive rather than evaluative.</td> </tr> <tr> <td data-bbox="320 1447 464 1496">0 marks</td> <td data-bbox="464 1447 1222 1496">No response or nothing worthy of credit.</td> </tr> </tbody> </table> <p data-bbox="320 1532 576 1561">Indicative content</p> <p data-bbox="320 1599 427 1628">Lactide</p> <ul data-bbox="320 1637 1198 1980" style="list-style-type: none"> • Lactide is a water-soluble biopolymer which quickly breaks down when exposed to the water in the dishwasher but is not broken down by the detergent stored inside. • As the capsule is biodegradable there is no waste packaging produced or negative environmental impact. • Lactide can break down prematurely if picked out of the bulk packaging with damp hands, resulting in the detergent capsule leaking. • If the capsule becomes compressed during transportation, damage could occur resulting in the detergent capsule leaking. 	Marks	Description	5–6 marks	The response includes detailed analysis and evaluation, comparing the two packaging methods with reference to factors such as transport, ease of use, and environmental impact.	3–4 marks	The response includes good analysis and evaluation of both packaging methods and draws some comparison with reference to factors such as transport, ease of use, and environmental impact.	1–2 marks	The response includes basic analysis and tends to be descriptive rather than evaluative.	0 marks	No response or nothing worthy of credit.	6 marks	AO3 2a AO3 2b
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0 marks	No response or nothing worthy of credit.													

	<p>Foil-based packaging</p> <ul style="list-style-type: none">• The foil-based packaging is impermeable to moisture and air so protects the compressed powdered detergent from breaking down before use.• If the tablet does become damaged in transit the foil-lined packaging will prevent the detergent from spilling and still allow it to be used.• The foil-based packaging has a polymer lining which makes it very difficult to recycle due to complications separating the materials.• The single use nature of the packaging and the rate at which the tablets are used will have a negative environmental impact and the waste will contribute to landfill. <p>This list is not exhaustive. Accept any other valid responses.</p>		
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Qu	Part	Marking Guidance	Total marks	AO																						
11		<p data-bbox="320 338 871 371">Figure 6 and Figure 7 show mug holders.</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <p data-bbox="533 412 639 445">Figure 6</p>  </div> <div style="text-align: center;"> <p data-bbox="922 412 1029 445">Figure 7</p>  </div> </div> <table border="1" data-bbox="320 801 1182 1081" style="margin: 10px auto;"> <thead> <tr> <th></th> <th data-bbox="587 801 884 857">Figure 6</th> <th data-bbox="884 801 1182 857">Figure 7</th> </tr> </thead> <tbody> <tr> <td data-bbox="320 857 587 913">Material</td> <td data-bbox="587 857 884 913">Beech</td> <td data-bbox="884 857 1182 913">Low-carbon Steel</td> </tr> <tr> <td data-bbox="320 913 587 992">Method of Manufacture</td> <td data-bbox="587 913 884 992">CNC turned</td> <td data-bbox="884 913 1182 992">Cold formed</td> </tr> <tr> <td data-bbox="320 992 587 1081">Method of Assembly</td> <td data-bbox="587 992 884 1081">Fabricated and glued</td> <td data-bbox="884 992 1182 1081">Fabricated and welded</td> </tr> </tbody> </table> <p data-bbox="320 1122 887 1155">Analyse and evaluate the two mug holders.</p> <p data-bbox="320 1189 775 1223">In your answer you should refer to:</p> <ul data-bbox="320 1256 807 1335" style="list-style-type: none"> • the suitability of the materials used • the manufacturing methods used. <table border="1" data-bbox="320 1357 1222 2029" style="margin: 10px auto;"> <thead> <tr> <th data-bbox="320 1357 464 1413">Marks</th> <th data-bbox="464 1357 1222 1413">Description</th> </tr> </thead> <tbody> <tr> <td data-bbox="320 1413 464 1637">9–12 marks</td> <td data-bbox="464 1413 1222 1637">The response shows a detailed analysis and evaluation of the suitability of the material and manufacturing process of both mug holders. The response evaluates how the properties of the material and the way in which each mug holder is manufactured affect the suitability and intended function.</td> </tr> <tr> <td data-bbox="320 1637 464 1794">5–8 marks</td> <td data-bbox="464 1637 1222 1794">The response shows good analysis and evaluation of the suitability of the material and manufacturing process of both mug holders, with appropriate reference to the target market and intended function.</td> </tr> <tr> <td data-bbox="320 1794 464 1984">1–4 marks</td> <td data-bbox="464 1794 1222 1984">Basic evaluation of the suitability of the material and manufacturing process of each of the mug holders, but response tends to be descriptive rather than evaluative or focuses on one material or manufacturing process only.</td> </tr> <tr> <td data-bbox="320 1984 464 2029">0 marks</td> <td data-bbox="464 1984 1222 2029">No response or nothing worthy of credit.</td> </tr> </tbody> </table>		Figure 6	Figure 7	Material	Beech	Low-carbon Steel	Method of Manufacture	CNC turned	Cold formed	Method of Assembly	Fabricated and glued	Fabricated and welded	Marks	Description	9–12 marks	The response shows a detailed analysis and evaluation of the suitability of the material and manufacturing process of both mug holders. The response evaluates how the properties of the material and the way in which each mug holder is manufactured affect the suitability and intended function.	5–8 marks	The response shows good analysis and evaluation of the suitability of the material and manufacturing process of both mug holders, with appropriate reference to the target market and intended function.	1–4 marks	Basic evaluation of the suitability of the material and manufacturing process of each of the mug holders, but response tends to be descriptive rather than evaluative or focuses on one material or manufacturing process only.	0 marks	No response or nothing worthy of credit.	<p data-bbox="1265 338 1353 405">12 marks</p>	<p data-bbox="1401 338 1505 405">AO3 2a AO3 2b</p>
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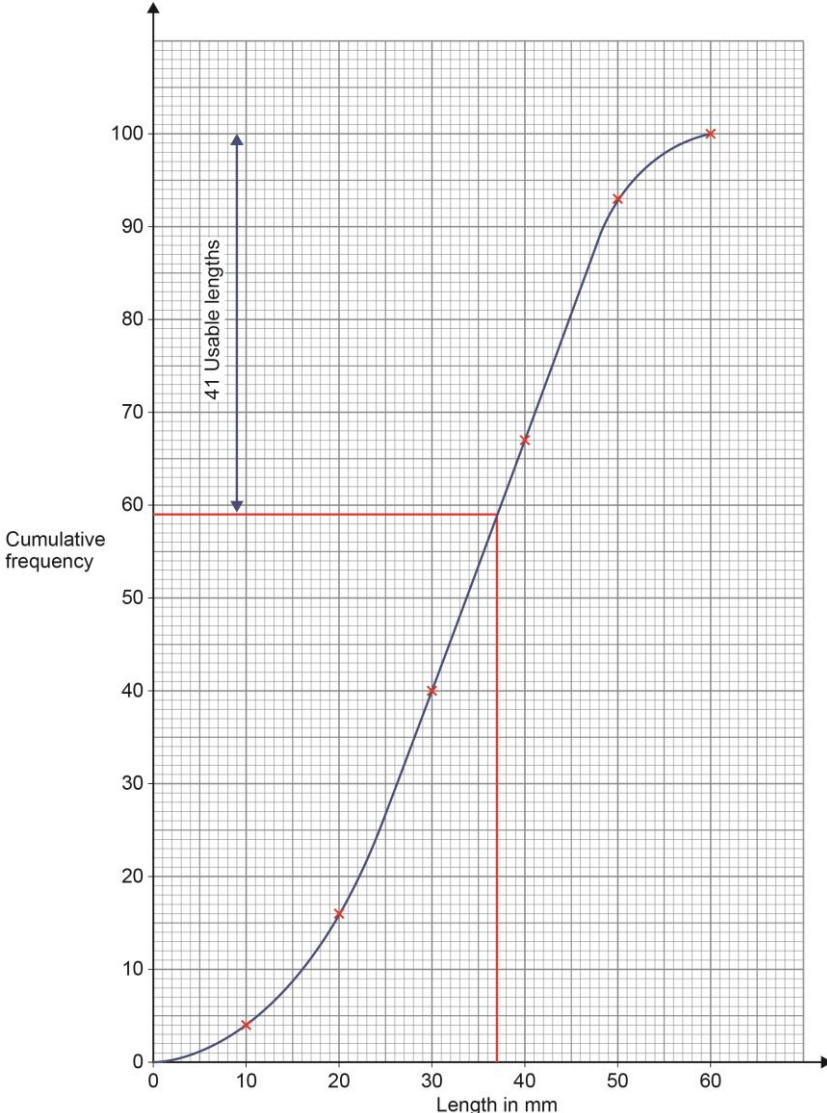
	<p>Indicative content</p> <p>Beech</p> <ul style="list-style-type: none"> • Beech is a hardwood with a tight grain meaning that it will not easily chip or splinter when mugs are hung or removed. • Beech can be varnished or oiled to protect the timber and provide a glossy aesthetic finish to match the décor of a customer kitchen. • Beech is a durable timber that will withstand the wear and tear associated with use and have an extended lifespan and not damage the mugs when being hung. • Beech is a hardwood which, although renewable, is not as sustainable as a softwood equivalent. <p>CNC turned</p> <ul style="list-style-type: none"> • CNC wood turning will create consistent profiles of timber which would be essential as all six hanging posts are identical. • The simple profile of the upright shaft and tapered nature of the hanging posts would be easily created by CNC wood turning. • There would be a large market for the product so the speed of production enabled by CNC manufacture would allow for efficient batch production. • There would be significant waste created when turning the individual components. <p>Fabricated and glued</p> <ul style="list-style-type: none"> • Profiles, flanges or recesses could be easily shaped during manufacture to increase the surface area of the glued joint. • The use of the same material for all components makes joining with an adhesive such as PVA or a resin equivalent suitable. • The adhesive may be susceptible to failure if damp mugs were continually hung causing the timber to expand and contract. <p>Low-carbon steel</p> <ul style="list-style-type: none"> • Low-carbon steel is a malleable material that can be easily formed into the simple shapes found in the mug holder. • Low-carbon steel can be drawn in to the thin wire profile needed for the mug holder. • Low-carbon steel is stiff enough to withstand the deflection caused by the weight of a mug being hung on the hanging posts. • Low-carbon steel can be chrome plated providing a modern and hygienic appearance appropriate for a kitchen setting. <p>Cold formed</p> <ul style="list-style-type: none"> • The angled profiles of the hanging posts and the shallow radii and circular base are all simple shapes that would be suitable for cold forming from low-carbon steel. • The repetitive nature of the hanging profiles means that automated bending jigs could be used to quickly and accurately produce the component parts. • When cold formed the metal tends to ‘spring back’ a little after forming. This may affect the consistent angle of the hanging profile. 		
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		<p>Fabricated and welded</p> <ul style="list-style-type: none">• Low-carbon steel can be easily MIG welded to provide a strong joint capable of holding the weight of a mug.• Welding is a quick process, so the fabricating of the holder would be suitable for batch production.• The filler material used in welding will be visible at each join, reducing the overall aesthetic of the product.• The shape of the holder lends itself well to a jig being used to hold the steel in place whilst welding. <p>This list is not exhaustive. Accept any other valid responses.</p>		
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		<p>Calculating the original volume of cylinder</p>	$\pi r^2 \times \text{height}$ $= \pi \times 109^2 \times 140$ $= [5\,222\,887, 5\,226\,214]$	<p>1 mark (M1)</p>		
		<p>Calculating the % waste</p>	$\frac{\text{their } [678\,474, 681\,495]}{\text{their } [5\,222\,887, 5\,226\,214]}$ <p>and $\times 100$</p> $= [12.9, 13.1]$ <p>100 – their [12.9, 13.1]</p> $= [86.9, 87.1] \text{ or } 87\%$	<p>1 mark (M1)</p> <p>1 mark (A1)</p>		
		<p>Calculating the % waste Where no working has been shown but final answer is accurate</p>	<p>= [86.9, 87.1] or 87% Waste</p>	<p>6 marks</p>		

Qu	Part	Marking Guidance	Total marks	AO										
13		<p>Describe how modular/cell production has improved efficiency in high-volume manufacture.</p> <table border="1" data-bbox="320 439 1214 1010"> <thead> <tr> <th data-bbox="320 439 453 495">Marks</th> <th data-bbox="453 439 1214 495">Description</th> </tr> </thead> <tbody> <tr> <td data-bbox="320 495 453 685">7–9 marks</td> <td data-bbox="453 495 1214 685">A detailed and thorough understanding of how modular/cell production has improved efficiency in high-volume manufacture. The response accurately identifies some relevant examples with a detailed explanation of how they impact efficiency.</td> </tr> <tr> <td data-bbox="320 685 453 871">4–6 marks</td> <td data-bbox="453 685 1214 871">The response demonstrates a good understanding of how modular/cell production has improved efficiency in high-volume manufacture. (At the top end of the band there may be some use of examples, though not all may be relevant.)</td> </tr> <tr> <td data-bbox="320 871 453 958">1–3 marks</td> <td data-bbox="453 871 1214 958">The response offers a basic understanding of modular/cell production.</td> </tr> <tr> <td data-bbox="320 958 453 1010">0 marks</td> <td data-bbox="453 958 1214 1010">No response or nothing worthy of credit.</td> </tr> </tbody> </table> <p data-bbox="320 1048 576 1081">Indicative content</p> <ul data-bbox="320 1115 1214 1843" style="list-style-type: none"> • A series of CNC machines are located in close proximity to each other in a cell, within a manufacturing facility to reduce the distance and time taken to move a component around a large manufacturing facility. • Should any larger distance need to be covered automatic guided vehicles (AGV's) would be used that take the most efficient path and communicate with the other AGV's. • The machines are organised in a logical sequence corresponding to the order in which they will be used to limit movement time and maximise efficiency. • The loading and unloading of each machine is automated and performed by a robotic arm. This ensures accuracy and efficiency as the movement of the workpiece is programmed to take the most direct path. There is no human error in either the transfer or in the removal/installation of the workpiece. • Some cell production may include manual machines and in these situations the operators are highly skilled and familiar with all of the machinery in their cell, allowing them to job share. • These cells are often rewarded for their productivity and as a result there is a shared desire to hit targets which in turn has a positive effect on the efficiency of a cell. <p data-bbox="320 1877 1182 1910">This list is not exhaustive. Accept any other valid responses.</p>	Marks	Description	7–9 marks	A detailed and thorough understanding of how modular/cell production has improved efficiency in high-volume manufacture. The response accurately identifies some relevant examples with a detailed explanation of how they impact efficiency.	4–6 marks	The response demonstrates a good understanding of how modular/cell production has improved efficiency in high-volume manufacture. (At the top end of the band there may be some use of examples, though not all may be relevant.)	1–3 marks	The response offers a basic understanding of modular/cell production.	0 marks	No response or nothing worthy of credit.	9 marks	AO4 1b
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14		<p>Explain how the inclusion of smart materials in electronic products aids the end-of-life disassembly.</p> <table border="1" data-bbox="320 439 1214 857"> <thead> <tr> <th data-bbox="320 439 459 495">Marks</th> <th data-bbox="459 439 1214 495">Description</th> </tr> </thead> <tbody> <tr> <td data-bbox="320 495 459 651">3–4 marks</td> <td data-bbox="459 495 1214 651">A good explanation of how smart materials are being used to help with the disassembly of electronic products. (At the top end of the mark band the examples will include justification.)</td> </tr> <tr> <td data-bbox="320 651 459 801">1–2 marks</td> <td data-bbox="459 651 1214 801">The response offers a basic explanation of how smart materials are being used to help with the disassembly of electronic products but tends to be generic and may not relate directly to the context.</td> </tr> <tr> <td data-bbox="320 801 459 857">0 marks</td> <td data-bbox="459 801 1214 857">No response or nothing worthy of credit.</td> </tr> </tbody> </table> <p data-bbox="320 891 576 925">Indicative content</p> <ul data-bbox="320 965 1214 1480" style="list-style-type: none"> • Shape memory polymers (SMP) and shape memory alloys (SMA) are starting to be used to replace traditional polymer fixings. • Active disassembly at the end of a product’s life reduces the amount of human interaction needed at this phase of the product lifecycle. • At the end of the product’s useful life the product may be heated or exposed to an electric current. These stimuli cause a change in shape of the fixing or fastening. • The reduction in size of the fixing or fastening or the adjustment in shape of a cantilever clip etc would allow for the fixing to become loose. • The contraction of the SMA or SMP component would enable either partial or complete removal of the joint. • The product may be vibrated to help separate the device into component parts. <p data-bbox="320 1514 1182 1547">This list is not exhaustive. Accept any other valid responses.</p>	Marks	Description	3–4 marks	A good explanation of how smart materials are being used to help with the disassembly of electronic products. (At the top end of the mark band the examples will include justification.)	1–2 marks	The response offers a basic explanation of how smart materials are being used to help with the disassembly of electronic products but tends to be generic and may not relate directly to the context.	0 marks	No response or nothing worthy of credit.	4 marks	AO4 1b
Marks	Description											
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0 marks	No response or nothing worthy of credit.											

Qu	Part	Marking Guidance	Total marks	AO														
15		<p>Table 1 shows the number of aluminium offcuts stored for use in a workshop.</p> <p style="text-align: center;">Table 1</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Length of offcut</th> <th>Frequency</th> </tr> </thead> <tbody> <tr> <td>$0 \leq x < 10$</td> <td>4</td> </tr> <tr> <td>$10 \leq x < 20$</td> <td>12</td> </tr> <tr> <td>$20 \leq x < 30$</td> <td>24</td> </tr> <tr> <td>$30 \leq x < 40$</td> <td>27</td> </tr> <tr> <td>$40 \leq x < 50$</td> <td>26</td> </tr> <tr> <td>$50 \leq x < 60$</td> <td>7</td> </tr> </tbody> </table> <p>Lengths that are longer than 37 mm are needed for a particular job.</p> <p>Complete the cumulative frequency curve and then estimate the number of lengths of aluminium over 37 mm long.</p> 	Length of offcut	Frequency	$0 \leq x < 10$	4	$10 \leq x < 20$	12	$20 \leq x < 30$	24	$30 \leq x < 40$	27	$40 \leq x < 50$	26	$50 \leq x < 60$	7	4 marks	AO4 1c
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$40 \leq x < 50$	26																	
$50 \leq x < 60$	7																	

Length of offcut	Frequency	Cumulative Frequency
$0 \leq x < 10$	4	4
$10 \leq x < 20$	12	16
$20 \leq x < 30$	24	40
$30 \leq x < 40$	27	67
$40 \leq x < 50$	26	93
$50 \leq x < 60$	7	100
	100	

Calculating the cumulative frequency (CF)	See image above	1 mark (A1)
Completing the CF curve	See image above	1 mark (M1)
Drawing lines from CF curve	See image above (Line drawn from 37 or the value 59)	1 mark (M1)
Interpreting the graph to establish the number of usable lengths	Total number of lengths – number under 37 mm = $100 - [58, 59, 60]$ = [40, 41, 42] lengths Use candidates figure providing the 37 mm length is accurately drawn on the x axis	1 mark (A1)
Number of lengths over 37 mm Where no working has been shown but final answer is accurate	= [40, 41, 42] lengths	4 marks
Number of lengths over 37 mm where <u>no graph</u> or working has been shown but final answer is accurate	= [40, 41, 42] lengths	2 marks
or		

		Calculating the cumulative frequency (CF)	See image above	1 mark (A1)		
		Completing the CF curve	See image above	1 mark (M1)		
		Calculating the number of lengths over 37 mm using interpolation	$7 + 26 + \left(\frac{3}{10} \times 27\right)$ or 41.1	1 mark (M1)		
		Number of lengths over 37 mm	= 41 lengths	1 mark (A1)		
		Number of lengths over 37 mm	= 41 lengths	4 marks		
		Where no working has been shown but final answer is accurate				
		Number of lengths over 37 mm where <u>no graph</u> or working has been shown but final answer is accurate	= 41 lengths	2 marks		


Qu	Part	Marking Guidance	Total marks	AO										
16		<p>Explain why manufacturers of flat-pack furniture provide customers with exploded diagrams.</p> <table border="1" data-bbox="320 439 1214 943"> <thead> <tr> <th data-bbox="320 439 461 495">Marks</th> <th data-bbox="461 439 1214 495">Description</th> </tr> </thead> <tbody> <tr> <td data-bbox="320 495 461 647">5–6 marks</td> <td data-bbox="461 495 1214 647">The response demonstrates a detailed and thorough understanding of why a company may provide an exploded diagram to a consumer with specific reference to the benefits to both the consumer and manufacturer.</td> </tr> <tr> <td data-bbox="320 647 461 799">3–4 marks</td> <td data-bbox="461 647 1214 799">The response demonstrates a good understanding of why a company may provide an exploded diagram to a consumer with some reference to how it is used by the consumer.</td> </tr> <tr> <td data-bbox="320 799 461 887">1–2 marks</td> <td data-bbox="461 799 1214 887">The response offers a basic explanation of the use of exploded diagrams.</td> </tr> <tr> <td data-bbox="320 887 461 943">0 marks</td> <td data-bbox="461 887 1214 943">No response or nothing worthy of credit.</td> </tr> </tbody> </table> <p>Indicative content</p> <ul data-bbox="320 1048 1214 1599" style="list-style-type: none"> • Exploded diagrams offer a visual explanation to the consumer of how the individual parts of the package assemble to create a piece of furniture. • They can be used to identify if any components are missing or if a spare part needs to be ordered. • A non-technical consumer is likely to be more successful identifying a component from a visual graphic opposed to a technical component description. • The lack of written annotation means that the company can distribute their product to a global market without the need to have instructions printed in a variety of languages. • Visual instructions are generally more successfully interpreted than a collection of written instructions so the product will be assembled more successfully. • Exploded diagrams can successfully communicate the order in which components need to be assembled. <p>This list is not exhaustive. Accept any other valid responses.</p>	Marks	Description	5–6 marks	The response demonstrates a detailed and thorough understanding of why a company may provide an exploded diagram to a consumer with specific reference to the benefits to both the consumer and manufacturer.	3–4 marks	The response demonstrates a good understanding of why a company may provide an exploded diagram to a consumer with some reference to how it is used by the consumer.	1–2 marks	The response offers a basic explanation of the use of exploded diagrams.	0 marks	No response or nothing worthy of credit.	6 marks	AO4 1c
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5–6 marks	The response demonstrates a detailed and thorough understanding of why a company may provide an exploded diagram to a consumer with specific reference to the benefits to both the consumer and manufacturer.													
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0 marks	No response or nothing worthy of credit.													

Qu	Part	Marking Guidance	Total marks	AO
17		<p>Define the term ‘composite’.</p> <p>Indicative content</p> <p>One mark for a simple definition:</p> <ul style="list-style-type: none"> • A composite is a material comprised of two or more different materials. <p>Two marks for a detailed definition:</p> <ul style="list-style-type: none"> • The material formed makes use of the properties of the two original materials to produce a new material with enhanced properties. <p>Accept any other valid responses.</p>	2 marks	AO4 1a


Qu	Part	Marking Guidance	Total marks	AO										
18		<p>Describe the role of a master production schedule (MPS) as part of production, planning and control networking.</p> <table border="1" data-bbox="320 439 1214 943"> <thead> <tr> <th data-bbox="320 439 461 495">Marks</th> <th data-bbox="461 439 1214 495">Description</th> </tr> </thead> <tbody> <tr> <td data-bbox="320 495 461 651">5–6 marks</td> <td data-bbox="461 495 1214 651">The response shows a detailed understanding of the role of an MPS. The response may refer to a variety of different functions that an MPS will manage within a manufacturing environment.</td> </tr> <tr> <td data-bbox="320 651 461 808">3–4 marks</td> <td data-bbox="461 651 1214 808">The response demonstrates a good understanding of the role of an MPS. The response may refer to some areas that an MPS will manage within a manufacturing environment.</td> </tr> <tr> <td data-bbox="320 808 461 887">1–2 marks</td> <td data-bbox="461 808 1214 887">The response offers a basic understanding of a master production schedule.</td> </tr> <tr> <td data-bbox="320 887 461 943">0 marks</td> <td data-bbox="461 887 1214 943">No response or nothing worthy of credit.</td> </tr> </tbody> </table> <p>Indicative content</p> <ul data-bbox="320 1048 1214 1771" style="list-style-type: none"> • An MPS provides clear and accurate information relating to the volume of a specific product that will be produced within a specific time frame. • An MPS is created using information from various different departments within a business, coordinating resources. • The shared nature of the document ensures that an accurate picture is always maintained and information is always up to date. • The MPS will provide information about the volume of workforce needed for a specific manufacturing task and then provide information about the availability of the workforce. • The MPS software will contain information relating to the volume of components needed to perform a manufacturing task. • The physical machinery capabilities and output is monitored in order to plan production times and distribution of the finished product. • It will contain detail of the stock, suppliers and delivery schedules for the relevant component. • MPS software will manage stock and ensure that orders are made to suppliers based on the required planned output of the manufacture. <p>This list is not exhaustive. Accept any other valid responses.</p>	Marks	Description	5–6 marks	The response shows a detailed understanding of the role of an MPS. The response may refer to a variety of different functions that an MPS will manage within a manufacturing environment.	3–4 marks	The response demonstrates a good understanding of the role of an MPS. The response may refer to some areas that an MPS will manage within a manufacturing environment.	1–2 marks	The response offers a basic understanding of a master production schedule.	0 marks	No response or nothing worthy of credit.	6 marks	AO4 1b
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3–4 marks	The response demonstrates a good understanding of the role of an MPS. The response may refer to some areas that an MPS will manage within a manufacturing environment.													
1–2 marks	The response offers a basic understanding of a master production schedule.													
0 marks	No response or nothing worthy of credit.													

Qu	Part	Marking Guidance	Total marks	AO
19		<p>Name a specific application for each of the following composites:</p> <p>One mark per correct application.</p> <p>Indicative content</p> <p>Aluminium composite board:</p> <ul style="list-style-type: none"> • indoor and outdoor signage • applications that use their sound absorbing properties such as panels in vehicles • architectural cladding. <p>Glass Reinforced Polymer (GRP):</p> <ul style="list-style-type: none"> • boats, canoes, jet skis • vehicle body work • coatings on sports equipment such as hockey sticks. <p>Glulam:</p> <ul style="list-style-type: none"> • engineered beams • bridges • architectural timber framework. <p>This list is not exhaustive. Accept any other valid responses.</p>	3 marks	AO4 1a

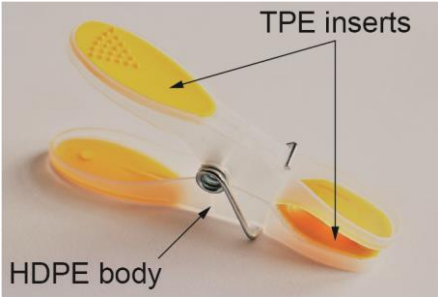
Qu	Part	Marking Guidance	Total marks	AO
20		<p>Define the following material properties:</p> <p>Thermal conductivity A measure of how successfully heat energy can travel through a material.</p> <p>Toughness A material's ability to absorb impact force without fracture.</p> <p>One mark per correct definition of the material properties.</p> <p>Accept any other valid responses.</p>	2 marks	AO4 1a

Qu	Part	Marking Guidance	Total marks	AO										
21		<p>Explain the manufacturing processes that would be used to manufacture the stainless steel ruler shown in Figure 9.</p> <p style="text-align: center;">Figure 9</p>  <table border="1" data-bbox="320 817 1214 1391"> <thead> <tr> <th data-bbox="320 817 459 875">Marks</th> <th data-bbox="459 817 1214 875">Description</th> </tr> </thead> <tbody> <tr> <td data-bbox="320 875 459 1061">5–6 marks</td> <td data-bbox="459 875 1214 1061">Detailed understanding of how a combination of punching, stamping and press forming have been used to produce the stainless steel ruler. Response accurately explains how both the lettering and profile of the ruler have been successfully achieved.</td> </tr> <tr> <td data-bbox="320 1061 459 1249">3–4 marks</td> <td data-bbox="459 1061 1214 1249">Good understanding of how a combination of punching, stamping and press forming have been used to produce the stainless steel ruler. Response may make limited reference to how the lettering and profile of the ruler is achieved.</td> </tr> <tr> <td data-bbox="320 1249 459 1339">1–2 marks</td> <td data-bbox="459 1249 1214 1339">Limited understanding of how the stainless steel ruler is manufactured.</td> </tr> <tr> <td data-bbox="320 1339 459 1391">0 marks</td> <td data-bbox="459 1339 1214 1391">No response or nothing worthy of credit.</td> </tr> </tbody> </table> <p>Indicative content</p> <ul data-bbox="320 1496 1214 1989" style="list-style-type: none"> • The debossed detail such as the brand name, the mm incremental indicators and the numbers on the ruler would have been achieved by stamping the stainless steel with an appropriate die under hydraulic pressure. Several rulers may be stamped simultaneously. • Following the debossing, the rectangular blank needed for the ruler would have been created from a larger sheet by punching the rectangular profile using a series of dies. • Detail such as the hanging hole would have been incorporated into the same punching die to improve efficiency. • The debossed, punched blank would now be press formed into the desired profile for the ruler. • The male and female die used would be produced from hardened steel in order to resist the wear of constant use. 	Marks	Description	5–6 marks	Detailed understanding of how a combination of punching, stamping and press forming have been used to produce the stainless steel ruler. Response accurately explains how both the lettering and profile of the ruler have been successfully achieved.	3–4 marks	Good understanding of how a combination of punching, stamping and press forming have been used to produce the stainless steel ruler. Response may make limited reference to how the lettering and profile of the ruler is achieved.	1–2 marks	Limited understanding of how the stainless steel ruler is manufactured.	0 marks	No response or nothing worthy of credit.	6 marks	AO4 1c
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1–2 marks	Limited understanding of how the stainless steel ruler is manufactured.													
0 marks	No response or nothing worthy of credit.													

		<ul style="list-style-type: none">• The stainless steel material would be compressed between a male and female die under significant hydraulic pressure in order to produce the 'm' profile seen on the ruler.• The press formed profile would be removed from the hydraulic press, inspected for quality before being packaged. <p>This list is not exhaustive. Accept any other valid responses.</p>		
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Qu	Part	Marking Guidance	Total marks	AO										
22		<p>Explain why cedar is commonly used in outdoor cladding such as the example shown in Figure 10.</p> <p style="text-align: center;">Figure 10</p>  <table border="1" data-bbox="320 813 1214 1352"> <thead> <tr> <th data-bbox="320 813 459 869">Marks</th> <th data-bbox="459 813 1214 869">Description</th> </tr> </thead> <tbody> <tr> <td data-bbox="320 869 459 1021">5–6 marks</td> <td data-bbox="459 869 1214 1021">A detailed explanation of why cedar is commonly used in outdoor cladding, with a wide range of appropriate justifications that may include aesthetics, working properties and suitability for the cladding context.</td> </tr> <tr> <td data-bbox="320 1021 459 1173">3–4 marks</td> <td data-bbox="459 1021 1214 1173">A good explanation of why cedar is commonly used in outdoor cladding. The response refers to some appropriate reasons that are related to the cladding context.</td> </tr> <tr> <td data-bbox="320 1173 459 1294">1–2 marks</td> <td data-bbox="459 1173 1214 1294">The response offers a basic explanation of why cedar is commonly used in outdoor cladding, but tends to provide generic material properties.</td> </tr> <tr> <td data-bbox="320 1294 459 1352">0 marks</td> <td data-bbox="459 1294 1214 1352">No response or nothing worthy of credit.</td> </tr> </tbody> </table> <p>Indicative content</p> <ul data-bbox="320 1458 1214 2051" style="list-style-type: none"> • Cedar is a quick growing softwood so very sustainable to use in building applications. Sustainability and the environmental impact used plays a significant role in most planning applications. • Cedar has an attractive red/brown colouration when installed and as it becomes weathered it changes to a grey/silver colouration. It is chosen by many for its aesthetic qualities. • Cedar is an excellent insulator of both sound and heat and as such makes it a suitable material to clad the exterior of buildings where heat loss and acoustic consideration are factors. • Cedar contains natural oils which make it resistant to moisture and weathering, meaning that the cladding will be durable in an outdoor application. • Cedar also has excellent resistance to insect attack and decay meaning that the cladding would require limited ongoing maintenance in contrast to other timbers. • Cedar is an easy material to shape and cut. This allows cladding to be cut to size quickly and easily on site. 	Marks	Description	5–6 marks	A detailed explanation of why cedar is commonly used in outdoor cladding, with a wide range of appropriate justifications that may include aesthetics, working properties and suitability for the cladding context.	3–4 marks	A good explanation of why cedar is commonly used in outdoor cladding. The response refers to some appropriate reasons that are related to the cladding context.	1–2 marks	The response offers a basic explanation of why cedar is commonly used in outdoor cladding, but tends to provide generic material properties.	0 marks	No response or nothing worthy of credit.	6 marks	AO4 1b
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1–2 marks	The response offers a basic explanation of why cedar is commonly used in outdoor cladding, but tends to provide generic material properties.													
0 marks	No response or nothing worthy of credit.													

		<ul style="list-style-type: none">• Cedar has a low mass compared to other timbers. This makes the cladding easier to lift and hold when being installed. <p>This list is not exhaustive. Accept any other valid responses.</p>		
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Qu	Part	Marking Guidance	Total marks	AO										
23		<p>Explain why high density polyethylene (HDPE) and thermoplastic elastomer (TPE) are suitable materials for the manufacture of the polymer clothes peg shown in Figure 11.</p> <p style="text-align: center;">Figure 11</p>  <table border="1" data-bbox="320 853 1214 1391"> <thead> <tr> <th>Marks</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>5–6 marks</td> <td>Detailed understanding of why HDPE and TPE are used in the manufacture of the polymer clothes peg. Response accurately refers to how the material properties of both HDPE and TPE effect the function of the peg and its suitability for use.</td> </tr> <tr> <td>3–4 marks</td> <td>Good understanding of why HDPE and TPE are used in the manufacture of the polymer clothes peg. Response may refer to aspects such as material properties, manufacture, and the peg application.</td> </tr> <tr> <td>1–2 marks</td> <td>Limited understanding of why HDPE and TPE are used for the polymer clothes peg.</td> </tr> <tr> <td>0 marks</td> <td>No response or nothing worthy of credit.</td> </tr> </tbody> </table> <p>Indicative content</p> <p>High density polyethylene (HDPE)</p> <ul style="list-style-type: none"> • HDPE has good resistance to weathering and clothes pegs are often left outside for extended durations of time. • HDPE is tough so will not be damaged if stored in a bag or basket, and will not crack or snap if dropped from height when in use. • HDPE is a stiff polymer that allows the user to open the peg and resist the force exerted by the spring. • HDPE is easily pigmented so the pegs can be produced in a wide range of colours to match consumer colour preference. <p>Thermoplastic elastomer (TPE)</p> <ul style="list-style-type: none"> • The TPE inserts provide a textured area where the user would interact with the peg, providing additional grip especially when the user may have damp hands. 	Marks	Description	5–6 marks	Detailed understanding of why HDPE and TPE are used in the manufacture of the polymer clothes peg. Response accurately refers to how the material properties of both HDPE and TPE effect the function of the peg and its suitability for use.	3–4 marks	Good understanding of why HDPE and TPE are used in the manufacture of the polymer clothes peg. Response may refer to aspects such as material properties, manufacture, and the peg application.	1–2 marks	Limited understanding of why HDPE and TPE are used for the polymer clothes peg.	0 marks	No response or nothing worthy of credit.	6 marks	AO4 1c
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1–2 marks	Limited understanding of why HDPE and TPE are used for the polymer clothes peg.													
0 marks	No response or nothing worthy of credit.													

		<ul style="list-style-type: none">• The TPE insert would be soft and flexible, providing additional friction where the clothes are secured and also preventing damage to delicate fabrics.• TPE can be successfully over moulded over the HDPE peg body, preventing the two materials from becoming detached from each other. <p>This list is not exhaustive. Accept any other valid responses.</p>		
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