



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

Paper 2 Designing and Making Principles

Mark scheme

June 2020

Version: 1.1 Final

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

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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>Figures 1 and 2 show two camping lanterns.</p> <table border="1" data-bbox="320 439 1209 819"> <thead> <tr> <th></th> <th>Figure 1</th> <th>Figure 2</th> </tr> </thead> <tbody> <tr> <td>Power source</td> <td>Burning oil</td> <td>Solar panel</td> </tr> <tr> <td>Operation of light</td> <td>Match</td> <td>Button</td> </tr> <tr> <td>Materials</td> <td>Low carbon steel sheet and glass</td> <td>Acrylonitrile Butadiene Styrene (ABS), Thermoplastic Elastomer (TPE) and Polycarbonate</td> </tr> <tr> <td>Manufacture</td> <td>Deformation and fabrication</td> <td>Redistribution and fabrication</td> </tr> </tbody> </table> <p>Compare the two camping lanterns.</p> <p>In your answer you should refer to:</p> <ul style="list-style-type: none"> • suitability of materials • manufacturing processes • power source. <table border="1" data-bbox="320 1133 1251 1912"> <thead> <tr> <th>Marks</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>9–12 marks</td> <td>Detailed comparison of both lanterns. Accurate information about points relating to suitability of materials, manufacturing processes and power sources. A number of different points from the indicative content will be explained, especially at the top end of the mark band. 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>5–8 marks</td> <td>Good comparison of both lanterns, referring to at least two of the reference points: (suitability of materials, manufacturing processes and power sources). At the lower end of the mark band there may less information relating to either of the two lanterns. The majority of points will be relevant.</td> </tr> <tr> <td>1–4 marks</td> <td>Limited comparison of the lanterns. At the lower end of the mark band little or no reference will be at least one of the reference points (suitability of materials, manufacturing processes and power sources) Points will often be generic and may show signs of confusion</td> </tr> <tr> <td>0 marks</td> <td>No response worthy of credit.</td> </tr> </tbody> </table>		Figure 1	Figure 2	Power source	Burning oil	Solar panel	Operation of light	Match	Button	Materials	Low carbon steel sheet and glass	Acrylonitrile Butadiene Styrene (ABS), Thermoplastic Elastomer (TPE) and Polycarbonate	Manufacture	Deformation and fabrication	Redistribution and fabrication	Marks	Description	9–12 marks	Detailed comparison of both lanterns. Accurate information about points relating to suitability of materials, manufacturing processes and power sources. A number of different points from the indicative content will be explained, especially at the top end of the mark band. 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	Good comparison of both lanterns, referring to at least two of the reference points: (suitability of materials, manufacturing processes and power sources). At the lower end of the mark band there may less information relating to either of the two lanterns. The majority of points will be relevant.	1–4 marks	Limited comparison of the lanterns. At the lower end of the mark band little or no reference will be at least one of the reference points (suitability of materials, manufacturing processes and power sources) Points will often be generic and may show signs of confusion	0 marks	No response worthy of credit.	12 marks	AO3 1A AO3 1B
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		<p>Indicative content:</p> <p>Suitability of materials</p> <ul style="list-style-type: none"> • The use of low carbon steel sheet for Figure 1 is ideal due to the oil power source due to the heat resistance of low carbon steel. • Low carbon steel is a thermal conductor meaning it will heat up during use and may be too hot to hold. • Low carbon steel is ideal for a camping lantern due to its toughness as camping lanterns are prone to being dropped and kicked over. • A finish is applied to the low carbon steel by power coating which may scratch revealing the material underneath to the elements and making it susceptible to corrosion. • The glass bulb section is ideal due to its transparency. • The glass will resist the temperature of the burning oil, but is prone to shattering with minimal impact force. • Figure 2 is formed from thermoplastics which are suitable for a solar power lantern where no direct heat source is in contact with the casing. • The thermoplastic casing is a thermal and electrical insulator making it a safer material than the low carbon steel in Figure 1 that may heat excessively, exposing the user to the risk of burns or fires in a tent. • The use of TPE on the casing gives texture and grip to the lantern, ideal for camping where the user may wear gloves reducing sensitivity in touch. • The polycarbonate casing for the LED bulbs is extremely tough, unlike the glass in Figure 1 and has glass like transparency. <p>Manufacturing processes</p> <ul style="list-style-type: none"> • The fabricated steel lantern would be press formed in several pieces that would be joined either by MIG welding, spot welding or riveting requiring multiple assembly processes on the production line. • The ABS camping lantern would be formed with several complex injection moulded components that clip together and hold all electronics within integral ribs and clips reducing production time and costs. • The TPE texture finish on Figure 2 would be added in the mould reducing labour and assembly processes compared to Figure 1. • The Polycarbonate bulb cover in Figure 2 would be injection moulded allowing the design to have an integrated diffuser to improve the lighting effect of the LED bulb. <p>Power sources</p> <ul style="list-style-type: none"> • The oil required for Figure 1 is a safety risk for the user and requires specialist vessels for carrying to the campsite, adding weight. • The oil for Figure 1 would have to be purchased from a specialist supplier and may not be readily available for camping. • The oil provides a multifunction lamp that also heats, ideal for camping. • If the user runs out of oil they may lose use of the lamp for the camping trip, unlike the solar powered lamp that will recharge during the day without the need for ‘consumables’ like the oil. 		
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		<ul style="list-style-type: none">• The LED bulbs mean that it is possible to power the lamp by solar power due to their low power consumption.• LED bulbs are also less fragile than standard bulbs making them ideal for a camping environment. <p>Students may also refer to safety aspects of the two lanterns and these points should be rewarded.</p> <p>Award any other valid responses.</p>		
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02		<p>Figures 3 and 4 show two packages for camping lanterns.</p> <p>Explain how the packaging for electronic products has changed over time and possible reasons for this.</p> <table border="1" data-bbox="320 539 1235 1218"> <thead> <tr> <th data-bbox="320 539 496 573">Marks</th> <th data-bbox="496 539 1235 573">Description</th> </tr> </thead> <tbody> <tr> <td data-bbox="320 573 496 880">5–6 marks</td> <td data-bbox="496 573 1235 880">Detailed explanation of the major changes in packaging for electronic products. Accurate information about points relating to changes and the reasons for these. A number of different points from the indicative content will be explained, especially at the top end of the mark band. 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="320 880 496 1048">3–4 marks</td> <td data-bbox="496 880 1235 1048">Good explanation of some changes in packaging for electronic products. Some reasoning about these changes is given. At the lower end of the mark band there may be limited reference to reasons for change. The majority of points will be relevant.</td> </tr> <tr> <td data-bbox="320 1048 496 1182">1–2 marks</td> <td data-bbox="496 1048 1235 1182">Limited information concerning changes in packaging over time. Basic explanation of reasons for change. At the lower end of the mark band little or no reference will be made to packaging for electronic products.</td> </tr> <tr> <td data-bbox="320 1182 496 1218">0 marks</td> <td data-bbox="496 1182 1235 1218">No response worthy of credit.</td> </tr> </tbody> </table> <p>Indicative content:</p> <ul data-bbox="320 1323 1257 2047" style="list-style-type: none"> • Packaging now has a greater focus on product promotion with packaging selling the product rather than a shop assistant. • A greater number of competing products means that packaging has to stand out more and often displays the product to show key features. • Online sales mean that packaging requires a greater amount of product protection due to increased transport. • Developments in die cutting technology has allowed the production of integral cardboard clips to remove the use of adhesives. • The volume of packaging has increased between Figures 3 and 4 with the use polymers raising sustainability issues due to increased landfill. • The introduction of the packaging directive. • The packaging directive states that all materials must be easily separated to aid disassembly. • All packaging must be labelled with the materials and recycling instructions so as not to have a negative effect on recycled materials. • Adhesives and permanent fixings should be replaced with temporary fixings to assist with recycling. • Packaging of electronic products must display details referring to RoHS, such as the crossed through wheelie bin. 	Marks	Description	5–6 marks	Detailed explanation of the major changes in packaging for electronic products. Accurate information about points relating to changes and the reasons for these. A number of different points from the indicative content will be explained, especially at the top end of the mark band. 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	Good explanation of some changes in packaging for electronic products. Some reasoning about these changes is given. At the lower end of the mark band there may be limited reference to reasons for change. The majority of points will be relevant.	1–2 marks	Limited information concerning changes in packaging over time. Basic explanation of reasons for change. At the lower end of the mark band little or no reference will be made to packaging for electronic products.	0 marks	No response worthy of credit.	6 marks	AO4 2C
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	<ul style="list-style-type: none"> The inclusion of toxic materials within packaging materials and finishes is restricted by the packaging directive. <p>Award any other valid responses.</p>		
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05		<p>Figure 8 shows the performance of a Direct Current (DC) motor under different loads (torque).</p> <p>Calculate the equation of the red line in Figure 8.</p> <p>Use this to calculate the stall torque (torque when the motor stops spinning) in Nm.</p> <p>Accept</p> <table border="1" data-bbox="320 703 1211 1368"> <thead> <tr> <th>Description</th> <th>Calculation</th> <th>Mark</th> </tr> </thead> <tbody> <tr> <td>Recognition of the equation for a straight line and calculation of gradient</td> <td>Gradient of line is $\frac{500}{-12.5}$ or $\frac{-500}{12.5}$ or -40</td> <td>1 mark</td> </tr> <tr> <td>Substitution of values into equation</td> <td>$y = -40x + 1300$ so $0 = -40x + 1300$</td> <td>1 mark</td> </tr> <tr> <td>Manipulation of equation to calculate x when y = 0</td> <td>$x = \frac{1300}{40} = 32.5$</td> <td>1 mark</td> </tr> <tr> <td>Calculation of x when y = 0 Where no working has been shown but final answer is accurate.</td> <td>32.5</td> <td>3 marks</td> </tr> </tbody> </table> <p>Or accept</p> <table border="1" data-bbox="320 1473 1217 2056"> <thead> <tr> <th>Description</th> <th>Calculation</th> <th>Mark</th> </tr> </thead> <tbody> <tr> <td>Recognition of the equation for a straight line and calculation of gradient</td> <td>reduction of 500 over 12.5 Nm</td> <td>1 mark</td> </tr> <tr> <td>Substitution of values into equation</td> <td>$\frac{1300}{500} \times 12.5$</td> <td>1 mark</td> </tr> <tr> <td>Manipulation of equation to calculate x when y = 0</td> <td>32.5</td> <td>1 mark</td> </tr> <tr> <td>Calculation of x when y = 0 Where no working has been shown but final answer is accurate.</td> <td>32.5</td> <td>3 marks</td> </tr> </tbody> </table>	Description	Calculation	Mark	Recognition of the equation for a straight line and calculation of gradient	Gradient of line is $\frac{500}{-12.5}$ or $\frac{-500}{12.5}$ or -40	1 mark	Substitution of values into equation	$y = -40x + 1300$ so $0 = -40x + 1300$	1 mark	Manipulation of equation to calculate x when y = 0	$x = \frac{1300}{40} = 32.5$	1 mark	Calculation of x when y = 0 Where no working has been shown but final answer is accurate.	32.5	3 marks	Description	Calculation	Mark	Recognition of the equation for a straight line and calculation of gradient	reduction of 500 over 12.5 Nm	1 mark	Substitution of values into equation	$\frac{1300}{500} \times 12.5$	1 mark	Manipulation of equation to calculate x when y = 0	32.5	1 mark	Calculation of x when y = 0 Where no working has been shown but final answer is accurate.	32.5	3 marks	3 marks	AO4 2C
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06		<p>Figure 9 shows the cross section of a low carbon steel blank used to press form a section of a motor casing.</p> <p>The blank is a regular hexagon with a central through hole.</p> <p>The blank has a volume of 12 500 mm³</p> <p>Calculate the thickness of the blank to two decimal places.</p> <table border="1" data-bbox="323 741 1251 2051"> <thead> <tr> <th data-bbox="323 741 660 801">Description</th> <th data-bbox="660 741 1115 801">Calculation</th> <th data-bbox="1115 741 1251 801">Mark</th> </tr> </thead> <tbody> <tr> <td data-bbox="323 801 660 1005">Area of one equilateral triangle in hexagon</td> <td data-bbox="660 801 1115 1005"> $= \frac{1}{2} \times 50 \times 50 \times \sin 60$ $= [1082.5, 1082.6]$ </td> <td data-bbox="1115 801 1251 1005">1 mark</td> </tr> <tr> <td data-bbox="323 1005 660 1198">so total area of hexagon is</td> <td data-bbox="660 1005 1115 1198"> $[1082.5, 1082.6] \times 6 =$ $[6495 - 6495.56]$ </td> <td data-bbox="1115 1005 1251 1198">1 mark</td> </tr> <tr> <td data-bbox="323 1198 660 1727">Calculate area of circle and remove from hexagon</td> <td data-bbox="660 1198 1115 1727"> Area of circle $A = \pi r^2$ $A = [3.14, 3.142] \times 15^2$ $A = [706.5, 706.95]$ Remove from hexagon $[6495, 6495.56] \text{ or their area } - [706.5, 706.95]$ $= [5788.05, 5790.06]$ </td> <td data-bbox="1115 1198 1251 1727">1 mark</td> </tr> <tr> <td data-bbox="323 1727 660 2051">Manipulate formula to calculate the thickness</td> <td data-bbox="660 1727 1115 2051"> $\text{Volume} = a \times h$ $12\,500 = [5788.05, 5790.06] \times h$ Therefore: $H = 12\,500 / [5788.05, 5790.06]$ $H = [2.158, 2.159]$ </td> <td data-bbox="1115 1727 1251 2051">1 mark</td> </tr> </tbody> </table>	Description	Calculation	Mark	Area of one equilateral triangle in hexagon	$= \frac{1}{2} \times 50 \times 50 \times \sin 60$ $= [1082.5, 1082.6]$	1 mark	so total area of hexagon is	$[1082.5, 1082.6] \times 6 =$ $[6495 - 6495.56]$	1 mark	Calculate area of circle and remove from hexagon	Area of circle $A = \pi r^2$ $A = [3.14, 3.142] \times 15^2$ $A = [706.5, 706.95]$ Remove from hexagon $[6495, 6495.56] \text{ or their area } - [706.5, 706.95]$ $= [5788.05, 5790.06]$	1 mark	Manipulate formula to calculate the thickness	$\text{Volume} = a \times h$ $12\,500 = [5788.05, 5790.06] \times h$ Therefore: $H = 12\,500 / [5788.05, 5790.06]$ $H = [2.158, 2.159]$	1 mark	4 marks	AO4 2C
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			H (thickness) = 2.16 mm			
		Calculating the thickness Where no working has been shown but final answer is accurate.	2.16mm	4 marks		
Qu	Part	Marking Guidance			Total marks	AO

07		<p>Explain how increased accuracy within production processes can reduce waste and improve efficiency.</p> <table border="1"> <thead> <tr> <th>Marks</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>5–6 marks</td> <td>Detailed understanding of the importance of accuracy in production processes. Relevant information about points relating to waste reduction and improved efficiency. A number of different points from the indicative content will be explained, especially at the top end of the mark band. 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>3–4 marks</td> <td>Good understanding of production process accuracy related to waste reduction or improved efficiency. At the lower end of the mark band some of the points made will be generic with limited explanation.</td> </tr> <tr> <td>1–2 marks</td> <td>Limited information concerning production process accuracy. Few points are made with generic reference to waste reduction or improved efficiency. At the lower end of the mark band little if any explanation of points will be offered.</td> </tr> <tr> <td>0 marks</td> <td>No response worthy of credit.</td> </tr> </tbody> </table> <p>Indicative content:</p> <p>Reducing Waste:</p> <ul style="list-style-type: none"> • The use of jigs and templates will reduce variation in repeated processes and waste materials. • Using jigs and fixtures will allow the use of temporary fixings to join standardised components that can be interchanged and replaced rather than replacing whole products during QC checks. • The use of Go no-go gauges allows quick and effective QC checks on dimensional accuracy within set tolerances to control production processes. • Setting accurate temperature tolerances in forming processes reduces variation in produced products and waste products. • Use of Six Sigma monitoring processes can reduce errors in final production and therefore reduce waste materials. 	Marks	Description	5–6 marks	Detailed understanding of the importance of accuracy in production processes. Relevant information about points relating to waste reduction and improved efficiency. A number of different points from the indicative content will be explained, especially at the top end of the mark band. 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	Good understanding of production process accuracy related to waste reduction or improved efficiency. At the lower end of the mark band some of the points made will be generic with limited explanation.	1–2 marks	Limited information concerning production process accuracy. Few points are made with generic reference to waste reduction or improved efficiency. At the lower end of the mark band little if any explanation of points will be offered.	0 marks	No response worthy of credit.	6 marks	AO4 2B
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	<ul style="list-style-type: none"> • Ensuring accuracy in tooling reduces errors in produced components • Accurate tessellation of components reduces waste materials in production processes. • Pre-production modelling allows accurate material volume ordering reducing surplus material for storage. <p>Improving Efficiency:</p> <ul style="list-style-type: none"> • Reduced storage for failed products (clearer workspaces). • Quicker identification of production processes errors due to tight QA procedures. • Better tracking of errors and prediction of errors. • Introduction of automated QC checks without human interaction give tighter tolerances. <p>Award any other valid responses.</p>		
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<p>08</p>	<p>Give two reasons why X-ray testing would be a suitable post-production test for a welded bridge structure.</p> <p>1 mark per relevant point.</p> <p>Indicative content:</p> <ul style="list-style-type: none"> • X-ray testing is an NDT (Non-Destructive Testing) method used to test products that can then be sold rather than recycled etc. • X-ray testing allows the operator to visualise internal defects within a welded joint. • A welded bridge structure is produced on a one-off basis meaning NDT testing is ideal. <p>Award any other valid responses.</p>	<p>2 marks</p>	<p>AO4 2A</p>
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Qu	Part	Marking Guidance	Total marks	AO										
09		<p>Explain how developments in manufacturing techniques affected the work of Bauhaus designers.</p> <table border="1" data-bbox="320 472 1251 1182"> <thead> <tr> <th data-bbox="320 472 496 506">Marks</th> <th data-bbox="496 472 1251 506">Description</th> </tr> </thead> <tbody> <tr> <td data-bbox="320 506 496 808">5–6 marks</td> <td data-bbox="496 506 1251 808">Detailed understanding of manufacturing techniques used by Bauhaus Design School. Accurate information about the impact of manufacturing developments on the work of Bauhaus Designers. A number of different points from the indicative content will be explained, especially at the top end of the mark band. 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="320 808 496 976">3–4 marks</td> <td data-bbox="496 808 1251 976">Good understanding of the main Bauhaus design principles. Some understanding of manufacturing techniques used by the Bauhaus are described. At the lower end of the mark band points made will lack explanation.</td> </tr> <tr> <td data-bbox="320 976 496 1144">1–2 marks</td> <td data-bbox="496 976 1251 1144">Limited information concerning manufacturing techniques used by the Bauhaus. When points are made they lack detail and explanation, often making generic statements not always relevant to Bauhaus designers.</td> </tr> <tr> <td data-bbox="320 1144 496 1182">0 marks</td> <td data-bbox="496 1144 1251 1182">No response worthy of credit.</td> </tr> </tbody> </table> <p>Indicative content:</p> <p>Form Follows Function mission statement of the design school embraced the machine age and modern manufacturing processes.</p> <p>Tubular steel</p> <ul style="list-style-type: none"> • The development of tubular steel allowed the production of single piece furniture, a key feature of Bauhaus designs. • The use of tubular steel lent itself to minimal designs without ornamentation as favoured by the ‘form follows function’ mission statement. • Chrome plated tubular steel gave a monochromatic minimal look without variation to standardise the appearance of products for the masses. • The Bauhaus wished to embrace the machine aesthetic created during production. <p>Laminated veneers</p> <ul style="list-style-type: none"> • Laminated veneers allowed the production of complex curved forms without the need for wastage processes. 	Marks	Description	5–6 marks	Detailed understanding of manufacturing techniques used by Bauhaus Design School. Accurate information about the impact of manufacturing developments on the work of Bauhaus Designers. A number of different points from the indicative content will be explained, especially at the top end of the mark band. 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	Good understanding of the main Bauhaus design principles. Some understanding of manufacturing techniques used by the Bauhaus are described. At the lower end of the mark band points made will lack explanation.	1–2 marks	Limited information concerning manufacturing techniques used by the Bauhaus. When points are made they lack detail and explanation, often making generic statements not always relevant to Bauhaus designers.	0 marks	No response worthy of credit.	6 marks	AO4 2B
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	<ul style="list-style-type: none"> • Identical forms could be reproduced using moulds and formers allowing large scale production that would reduce costs to the customer and make products accessible to all. <p>Specific examples:</p> <p>B3 Wassily chair</p> <ul style="list-style-type: none"> • Production of a lightweight frame armchair with elasticity associated with tubular steel. • Monochromatic colour scheme which was easily adjustable with a variety of leather components. <p>Cesca Chair</p> <ul style="list-style-type: none"> • Cantilever chair design striving towards ‘fried air’ concept associated with the design school. <p>Award any other valid responses.</p>		
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Qu	Part	Marking Guidance	Total marks	AO
10		<p>Give four effective uses of project management systems that can benefit designers and manufacturers.</p> <p>1 mark per relevant point</p> <p>Indicative content:</p> <p>Project management systems benefit designers and manufacturers by:</p> <ul style="list-style-type: none"> • Project management systems, such as Six Sigma are used in identifying areas of weakness/waste within a process. • By using project management systems, such as Critical Path Analysis (CPA) designers and manufacturers can streamline processes removing unnecessary stages. • Manufacturers can reduce waste production by making to order. • By involving all members of a design/manufacture team in decisions TQM can increase efficiency: reducing processing time, reducing movement within the production process, reducing process equipment. • Project management systems can also improve supply efficiencies between manufacturers. <p>Award any other valid responses.</p>	4 marks	AO4 2A
11		<p>Define what is meant by an iterative design process.</p> <p>1 mark per relevant point.</p> <p>1 mark for explanation that multiple possible prototypes/versions of a single product are produced.</p> <p>1 mark for reference to developed with changes based on client feedback.</p> <p>Indicative content:</p> <p>An iterative design process involves continuous improvement where designs are prototyped and evaluated before being refined. After release onto the market products may be refined and released as newer versions with updates.</p> <p>Award any other valid responses.</p>	2 marks	AO4 2A

Qu	Part	Marking Guidance	Total marks	AO										
12		<p>Figure 10 shows drawing views of a zinc alloy component.</p> <p>Describe the pre-production procedures a manufacturer would go through to prepare for die casting 100 000 copies of the component.</p> <p>In your answer you should refer to:</p> <ul style="list-style-type: none"> • design modifications • machinery preparation • how a manufacturer would use computer modelling for quality assurance (QA). <table border="1" data-bbox="316 786 1246 1464"> <thead> <tr> <th data-bbox="316 786 480 824">Marks</th> <th data-bbox="480 786 1246 824">Description</th> </tr> </thead> <tbody> <tr> <td data-bbox="316 824 480 1093">5–6 marks</td> <td data-bbox="480 824 1246 1093">Detailed understanding of pre-production preparation for die casting Figure 10. Accurate information about points relating to design modifications, machinery preparation and computer modelling for QA. A number of different points from the indicative content will be explained, especially at the top end of the mark band.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="316 1093 480 1294">3–4 marks</td> <td data-bbox="480 1093 1246 1294">Good understanding of pre-production preparation. A range of different points from the indicative content are explained but may not always be specific to modifications needed for die casting. At the lower end of the mark band there may be a focus on one of the three reference points.</td> </tr> <tr> <td data-bbox="316 1294 480 1429">1–2 marks</td> <td data-bbox="480 1294 1246 1429">Limited information concerning preparation for die-casting. Generic points are made discussing die casting as a process. At the lower end of the mark band little or no reference is made pre-production procedures.</td> </tr> <tr> <td data-bbox="316 1429 480 1464">0 marks</td> <td data-bbox="480 1429 1246 1464">No response worthy of credit.</td> </tr> </tbody> </table> <p>Indicative content:</p> <p>Design modifications</p> <ul style="list-style-type: none"> • Inclusion of corner radii to allow for mould removal. • Addition of draft angles to ease mould removal. • Inclusion of ribs and webs to reduce material volume and reduce risk of shrinkage upon cooling. <p>Machinery preparation</p> <ul style="list-style-type: none"> • Production of a mould/sample before final production begins to check set up. • Production of metallic die for forming the component. • Test run from first die to check performance. • Inclusion of cooling channels to reduce cooling time during forming. 	Marks	Description	5–6 marks	Detailed understanding of pre-production preparation for die casting Figure 10 . Accurate information about points relating to design modifications, machinery preparation and computer modelling for QA. A number of different points from the indicative content will be explained, especially at the top end of the mark band.or lack of clarity in some points but this will not detract from the overall quality of the response.	3–4 marks	Good understanding of pre-production preparation. A range of different points from the indicative content are explained but may not always be specific to modifications needed for die casting. At the lower end of the mark band there may be a focus on one of the three reference points.	1–2 marks	Limited information concerning preparation for die-casting. Generic points are made discussing die casting as a process. At the lower end of the mark band little or no reference is made pre-production procedures.	0 marks	No response worthy of credit.	6 marks	AO4 2B
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		<p>Quality Assurance/Control</p> <ul style="list-style-type: none">• Use of CFD software to locate appropriate sprue/injection point to prevent 'short' volume.• Use of CFD to analyse cooling rates and calculate cycle times per moulding.• Planning of QC checks for production line to monitor component reliability. <p>Award any other valid responses.</p>		
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Qu	Part	Marking Guidance	Total marks	AO												
13		<p>Figures 11 and 12 show a cantilever chair component formed from laminated veneers.</p> <p>When forming the chair an allowance of 5% must be added to the length.</p> <p>Calculate the length of laminated veneer, represented by the red line, needed to form the chair in a single piece to the nearest mm.</p> <p>For this calculation you should ignore material thickness.</p> <p>The component is constructed from straight lines and circular arcs.</p> <table border="1" data-bbox="320 808 1211 1991"> <thead> <tr> <th data-bbox="320 808 639 871">Description</th> <th data-bbox="639 808 1077 871">Calculation</th> <th data-bbox="1077 808 1211 871">Mark</th> </tr> </thead> <tbody> <tr> <td data-bbox="320 871 639 1541">Calculate the length of the curved sections</td> <td data-bbox="639 871 1077 1541"> Circumference of a circle: $Circumference = 2\pi r$ Arc length = $2\pi r \div 360 \times angle$ Arc 1 = $(2\pi \times 40) \div 360 \times (180 - 100)$ = [251.2, 251.36] $\div 360 \times (180 - 100)$ = [55.82, 55.86] Arc 2 = $(2\pi \times 90) \div 360 \times 90$ = [565.2, 565.56] $\div 360 \times 90$ =[141.3, 141.39] Arc 3 = $(2\pi \times 90) \div 360 \times 90$ = [565.2, 565.56] $\div 360 \times 90$ =[141.3, 141.39] Total length of arcs = [338.42, 338.64] </td> <td data-bbox="1077 871 1211 1541">1 mark</td> </tr> <tr> <td data-bbox="320 1541 639 1767">Length of straight sections and arcs</td> <td data-bbox="639 1541 1077 1767"> Straight sections: $340 + 330 + 290 + 385 = 1345$ + their [338.42, 338.64] Total length: [1683.42, 1683.64] mm </td> <td data-bbox="1077 1541 1211 1767">1 mark</td> </tr> <tr> <td data-bbox="320 1767 639 1991">Adding 5% allowance and rounding to nearest mm</td> <td data-bbox="639 1767 1077 1991"> their [1683.42, 1683.64] $\times 1.05$ = [1767.59, 1767.82] = 1768 mm </td> <td data-bbox="1077 1767 1211 1991">1 mark</td> </tr> </tbody> </table>	Description	Calculation	Mark	Calculate the length of the curved sections	Circumference of a circle: $Circumference = 2\pi r$ Arc length = $2\pi r \div 360 \times angle$ Arc 1 = $(2\pi \times 40) \div 360 \times (180 - 100)$ = [251.2, 251.36] $\div 360 \times (180 - 100)$ = [55.82, 55.86] Arc 2 = $(2\pi \times 90) \div 360 \times 90$ = [565.2, 565.56] $\div 360 \times 90$ =[141.3, 141.39] Arc 3 = $(2\pi \times 90) \div 360 \times 90$ = [565.2, 565.56] $\div 360 \times 90$ =[141.3, 141.39] Total length of arcs = [338.42, 338.64]	1 mark	Length of straight sections and arcs	Straight sections: $340 + 330 + 290 + 385 = 1345$ + their [338.42, 338.64] Total length: [1683.42, 1683.64] mm	1 mark	Adding 5% allowance and rounding to nearest mm	their [1683.42, 1683.64] $\times 1.05$ = [1767.59, 1767.82] = 1768 mm	1 mark	3 marks	AO4 2C
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Qu	Part	Marking Guidance	Total marks	AO										
14	1	<p>Analyse and evaluate the success of two portable MP3 players using the data shown in the Product Life Cycle (PLC) graph in Figure 13</p> <table border="1" data-bbox="320 472 1251 1249"> <thead> <tr> <th data-bbox="320 472 496 506">Marks</th> <th data-bbox="496 472 1251 506">Description</th> </tr> </thead> <tbody> <tr> <td data-bbox="320 506 496 842">5–6 marks</td> <td data-bbox="496 506 1251 842">Detailed analysis and evaluation of the PLC graph. Accurate information about each of the major stages in the life cycle of each MP3 player comparing the information displayed on the graph is discussed. A number of different points from the indicative content will be explained, especially at the top end of the mark band. 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="320 842 496 1043">3–4 marks</td> <td data-bbox="496 842 1251 1043">Good analysis and some evaluation of the PLC graph. The major points shown on the PLC graphs are discussed. At the lower end of the mark band there may be some generic reference to stages of a PLC graph unrelated to the MP3 players in the question.</td> </tr> <tr> <td data-bbox="320 1043 496 1211">1–2 marks</td> <td data-bbox="496 1043 1251 1211">Basic analysis and very little evaluation of PLC graphs in general. Some reference may be made to overall success of the MP3 players shown, but this is holistic. At the lower end of the mark band little or no reference will be to the MP3 player context.</td> </tr> <tr> <td data-bbox="320 1211 496 1249">0 marks</td> <td data-bbox="496 1211 1251 1249">No response worthy of credit.</td> </tr> </tbody> </table> <p>Indicative content:</p> <ul data-bbox="320 1357 1251 1800" style="list-style-type: none"> • Both products were launched at approximately the same time. • MP3 A failed to enter the growth phase and was effectively removed following an unsuccessful introduction. • The decline of MP3 A was rapid. • MP3 A was removed from the market while MP3 B sales were still in the growth phase. • MP3 B went through all stages of the Product Life Cycle. • The maximum number of sales of MP3 B were 10 times that of MP3 A. • The decline of MP3 B sales was very slow in comparison to MP3 A. • The success of MP3 B would lead you to expect product extension strategies to be in place to prevent the decline in sales seen from 2009 onwards. <p>Award any other valid responses.</p>	Marks	Description	5–6 marks	Detailed analysis and evaluation of the PLC graph. Accurate information about each of the major stages in the life cycle of each MP3 player comparing the information displayed on the graph is discussed. A number of different points from the indicative content will be explained, especially at the top end of the mark band. 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	Good analysis and some evaluation of the PLC graph. The major points shown on the PLC graphs are discussed. At the lower end of the mark band there may be some generic reference to stages of a PLC graph unrelated to the MP3 players in the question.	1–2 marks	Basic analysis and very little evaluation of PLC graphs in general. Some reference may be made to overall success of the MP3 players shown, but this is holistic. At the lower end of the mark band little or no reference will be to the MP3 player context.	0 marks	No response worthy of credit.	6 marks	AO3 2A AO3 2B
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14	2	<p>Explain how a manufacturer of music players can prevent the decline in sales of their product.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">Marks</th> <th style="text-align: center;">Description</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">5–6 marks</td> <td>Detailed explanation of possible extension strategies used to prevent a decline in product sales. Accurate information about points relating to appropriate extension strategies for music players. A number of different points from the indicative content will be explained, especially at the top end of the mark band. 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 style="text-align: center;">3–4 marks</td> <td>Good explanation of some appropriate extension strategies. Most of the points made are relevant to the music context and are explained. At the lower end of the mark band there may be a reliance on generic strategies.</td> </tr> <tr> <td style="text-align: center;">1–2 marks</td> <td>Limited information concerning extension strategies is given. Basic explanation of methods to increase sales are given with little, if any, specific reference to music players.</td> </tr> <tr> <td style="text-align: center;">0 marks</td> <td>No response worthy of credit.</td> </tr> </tbody> </table> <p>Indicative content:</p> <ul style="list-style-type: none"> • The establishing of a brand specific software to support the music uploading procedure. • The use of specific file types within ties users into the software and brand. • The use of aggressive marketing campaigns and product placement with major celebrities increased brand recognition. • The introduction of USP features for their products, such as white earphones, edge to edge display, intuitive graphical user interface means consumers return to the brand they have loyalty to. • The introduction of regularly updated versions keeps fashion conscious users coming back for more. • Using regular software updates products can be revitalised without complete redesigns. • By increasing the storage available while keeping the minimal product aesthetics the user does not feel they will have to start again when updating. • Introducing special editions and product placement in films etc can boost sales. • Combining features of multiple products reduces the need for multiple devices. • The downloading of paid for applications and back up facility for products means upgrading within the same product range is simple and therefore the easiest option. • Linking with other companies for peripherals such as earphones can widen your audience. <p>Award any other valid responses.</p>	Marks	Description	5–6 marks	Detailed explanation of possible extension strategies used to prevent a decline in product sales. Accurate information about points relating to appropriate extension strategies for music players. A number of different points from the indicative content will be explained, especially at the top end of the mark band. 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	Good explanation of some appropriate extension strategies. Most of the points made are relevant to the music context and are explained. At the lower end of the mark band there may be a reliance on generic strategies.	1–2 marks	Limited information concerning extension strategies is given. Basic explanation of methods to increase sales are given with little, if any, specific reference to music players.	0 marks	No response worthy of credit.	6 marks	AO3 2A AO3 2B
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Qu	Part	Marking Guidance	Total marks	AO
15		<p>Give two reasons why companies conform to International Standards Organisation (ISO) standards.</p> <p>1 mark per reason.</p> <ul style="list-style-type: none"> • Gives customers/consumers etc greater faith/confidence in the company. • Gives a company a competitive edge. • Helps regulators to ensure that companies meet specific health safety or environmental conditions. • Provides reassurances to other companies using their products. • Increases their relevance in the global marketplace. <p>Award any other valid responses.</p>	2 marks	AO4 2A