



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

Paper 2 Designing and Making Principles

Mark scheme

June 2021

Version: 1.0 Final



Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead 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>Figures 1 and 2 show two step ladders.</p> <p>Compare and evaluate the two step ladders shown.</p> <p>In your answer you should refer to:</p> <ul style="list-style-type: none"> design safety ergonomic factors. <table border="1" data-bbox="320 640 1211 815"> <thead> <tr> <th></th> <th>Figure 1</th> <th>Figure 2</th> </tr> </thead> <tbody> <tr> <td>Main manufacture process</td> <td>Wood wastage techniques</td> <td>Aluminium extrusion</td> </tr> <tr> <td>Joining methods</td> <td>Adhesive and screws</td> <td>Nuts and bolts</td> </tr> <tr> <td>Applied finish</td> <td>Clear varnish</td> <td>Self-finishing</td> </tr> </tbody> </table> <table border="1" data-bbox="320 848 1211 1429"> <thead> <tr> <th>Marks</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>9–12 marks</td> <td>The response provides detailed comparison and evaluation of both step ladders, referring with technical details to both ergonomics and design safety. The response makes judgements regarding the design of both products using the full range of data provided.</td> </tr> <tr> <td>5–8 marks</td> <td>The response provides a good comparison of the two step ladders referring to both reference points. The response makes analytical judgements regarding to design of both products referring to some aspects of the data provided.</td> </tr> <tr> <td>1–4 marks</td> <td>The step ladders are compared in basic terms with limited use of the data provided. Responses may refer to elements such as material properties without linking these to the bullet points.</td> </tr> <tr> <td>0 marks</td> <td>No response or nothing worthy of credit.</td> </tr> </tbody> </table> <p>Indicative content</p> <p>The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above.</p> <ul style="list-style-type: none"> Figure 1 is made from a thermal insulator which will not respond to environmental changes as much as Figure 2, meaning use in hot or cold conditions will not make it difficult to touch/hold. Figure 1 is made from a natural material which may splinter due to the grain structure whereas Figure 2 is not weakened by grain structure. Figure 1 may distort within damp conditions due to natural materials used. Figure 2 will be stable in all conditions. Figure 1 will be shaped by wastage methods and steps/handles will wear over time to users' feet and hand positions. Figure 2 is made of a much harder material which will not be affected as easily, keeping the original form. 		Figure 1	Figure 2	Main manufacture process	Wood wastage techniques	Aluminium extrusion	Joining methods	Adhesive and screws	Nuts and bolts	Applied finish	Clear varnish	Self-finishing	Marks	Description	9–12 marks	The response provides detailed comparison and evaluation of both step ladders, referring with technical details to both ergonomics and design safety. The response makes judgements regarding the design of both products using the full range of data provided.	5–8 marks	The response provides a good comparison of the two step ladders referring to both reference points. The response makes analytical judgements regarding to design of both products referring to some aspects of the data provided.	1–4 marks	The step ladders are compared in basic terms with limited use of the data provided. Responses may refer to elements such as material properties without linking these to the bullet points.	0 marks	No response or nothing worthy of credit.	12 marks	AO3 1a AO3 1b
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	<ul style="list-style-type: none"> • Figure 1 requires a solid structure to keep rigidity. Figure 2 is constructed of hollow extrusions keeping weight down while ensuring rigidity. • Figure 1 requires an applied finish which may chip causing weakness. Figure 2 requires no applied finish. • Figure 1 is an electrical insulator making it ideal for electrical work, whereas Figure 2 is a conductor making it a risk of becoming live in an electrical accident. • Figure 2 would be suitable for storage outdoors but Figure 1 would be susceptible to changes in weather conditions. • Figure 2 may have grooves added within the step extrusions for added grip. • The aluminium ladder in Figure 2 can be made lighter in weight due to extrusions not possible in Figure 1. • Aluminium extrusions in Figure 2 may need polymer end caps to prevent floor damage or trapped fingers. • Figure 2 may become loose due to nuts and bolts. • Figure 1 may become loose over time due to wood joints • Use of locking nuts on Figure 2 will reduce risk of coming loose. • The wide bases on both ladders provides a stable structure when in use. • Figure 2 provides additional support for the user at the top of the ladder and a larger platform for storing items. • The additional feet on Figure 2 increases grip on floor surfaces. <p>Accept any other valid responses.</p>		
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Qu	Part	Marking Guidance	Total marks	AO
02		<p>Figure 3 shows a 2D view of a 2 metre step ladder.</p> <p>The step ladder is angled at 15 degrees from the vertical wall and stands on a horizontal floor.</p> <p>The ladder has 5 steps with even spacing of 300 mm between each step.</p> <p>The first step is 300 mm from the bottom of the ladder.</p> <p>Calculate the vertical height of the 5th step from the floor to the nearest mm.</p> <p>Find height along ladder 5×300 or 1500 1 mark</p> <p>Set up appropriate trigonometrical equation $\cos 15 = \frac{\text{height}}{\text{their } 1500}$ 1 mark</p> <p style="text-align: center;">or</p> <p style="text-align: center;">height = their 1500 \times cos 15</p> <p>Evaluate height [1448.8, 1448.9] 1 mark</p> <p>Round to nearest mm 1449 1 mark</p> <p>Round to nearest mm 1449 4 marks</p> <p>Correct answer without working is awarded full marks</p>	4 marks	AO4 2c

Qu	Part	Marking Guidance	Total marks	AO										
03		<p>Describe the testing procedures required during product development to ensure a step ladder is safe for sale.</p> <table border="1" data-bbox="320 434 1217 813"> <thead> <tr> <th data-bbox="320 434 504 470">Marks</th> <th data-bbox="504 434 1217 470">Description</th> </tr> </thead> <tbody> <tr> <td data-bbox="320 470 504 573">5–6 marks</td> <td data-bbox="504 470 1217 573">The response gives a detailed description of appropriate testing procedures that are directly related to the step ladder context.</td> </tr> <tr> <td data-bbox="320 573 504 676">3–4 marks</td> <td data-bbox="504 573 1217 676">The response gives a good description of testing procedures, some of which are appropriate to the step ladder context.</td> </tr> <tr> <td data-bbox="320 676 504 779">1–2 marks</td> <td data-bbox="504 676 1217 779">The response gives a basic description of generic testing procedures that could be used for checking product safety prior to sale.</td> </tr> <tr> <td data-bbox="320 779 504 813">0 marks</td> <td data-bbox="504 779 1217 813">No response or nothing worthy of credit.</td> </tr> </tbody> </table> <p>Indicative content</p> <p>The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above.</p> <ul style="list-style-type: none"> • Small group testing with possible users would allow the manufacturer to check the ease of use, including safety information and accessibility of key features on the product. • The readability/intuitive appearance of the safety labelling/ideograms would need testing with a range of users including users with language issues. • Weight restrictions will need testing over multiple uses, this would be done with specific forces being applied at all angles to check for longevity. • The ladder would be tested for stability against tipping in case of uneven loading etc. • Locking mechanisms would be checked for ease of application. • Repetitive use of mechanism/hinges without failure. • Testing on folding/closing the ladder would check for possible finger trapping/pinching hazards. • Completion of appropriate BSI certification for step ladders. • FEA (Finite Element Analysis)/relevant computer simulation may have taken place to check loadings on the ladder. • Material testing prior to production. <p>Accept any other valid responses.</p>	Marks	Description	5–6 marks	The response gives a detailed description of appropriate testing procedures that are directly related to the step ladder context.	3–4 marks	The response gives a good description of testing procedures, some of which are appropriate to the step ladder context.	1–2 marks	The response gives a basic description of generic testing procedures that could be used for checking product safety prior to sale.	0 marks	No response or nothing worthy of credit.	6 marks	AO4 2c
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04		<p>Figure 4 shows a range of safety instructions used on a loft ladder.</p> <p>Analyse and evaluate how the images shown in Figure 4 effectively communicate the safety instructions to the user.</p> <table border="1" data-bbox="320 504 1214 882"> <thead> <tr> <th data-bbox="320 504 504 539">Marks</th> <th data-bbox="504 504 1214 539">Description</th> </tr> </thead> <tbody> <tr> <td data-bbox="320 539 504 640">5–6 marks</td> <td data-bbox="504 539 1214 640">The response gives a detailed analysis of the range of safety ideograms shown evaluating readability and clarity of instruction to all for individual aspects.</td> </tr> <tr> <td data-bbox="320 640 504 741">3–4 marks</td> <td data-bbox="504 640 1214 741">The response gives a good analysis of the ideograms shown evaluating the instructions as a whole.</td> </tr> <tr> <td data-bbox="320 741 504 842">1–2 marks</td> <td data-bbox="504 741 1214 842">The response gives a basic analysis of the ideograms shown with generic observations lacking any depth of evaluation.</td> </tr> <tr> <td data-bbox="320 842 504 882">0 marks</td> <td data-bbox="504 842 1214 882">No response or nothing worthy of credit.</td> </tr> </tbody> </table> <p>Indicative content</p> <p>The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above.</p> <ul data-bbox="320 1086 1214 2016" style="list-style-type: none"> • Images are small and hard to understand due to lack of colour contrast. • Text is small and hard to read. • Use of images does assist understanding • Images used are non-standard but improve communication over text only. • Use of tick and cross symbols gives clarity to the user. • Stage 1 is very generic and does not clarify what to look for as damage. • Stage 2 requires manufacturer’s instruction manual as well which will not be present when using the ladder. • Stage 3 text is clear but small, image is confusing and could do with being bigger. • Stage 4 WARNING blends in as in the same colour as rest of text. It is not clear what locks are being referred to. Could be labelled with letters etc. • Stage 5 use of a 2D image is helpful, but may not be clear to the user. • Stage 6 image is very unclear and could do with being an outline of a hand rather than the whole person. • Stage 7 image is unclear and text small cross on white background contrasts with tick on white background. • Stage 8 use of standardised symbol for electrical hazard. • Ideograms are positioned on side of ladder this may not be seen during use. 	Marks	Description	5–6 marks	The response gives a detailed analysis of the range of safety ideograms shown evaluating readability and clarity of instruction to all for individual aspects.	3–4 marks	The response gives a good analysis of the ideograms shown evaluating the instructions as a whole.	1–2 marks	The response gives a basic analysis of the ideograms shown with generic observations lacking any depth of evaluation.	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"> Maximum weight restriction shown in both kilograms and stones using white text on black to stand out from the rest of the ideograms. <p>Accept any other valid responses.</p>		
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Qu	Part	Marking Guidance	Total marks	AO
05		<p>State two specific forms of anthropometric data used in the development of a step ladder.</p> <p>One mark per form of anthropometric data.</p> <p>Indicative content</p> <p>The guidance provided is illustrative and not exhaustive.</p> <p>Anthropometric data:</p> <ul style="list-style-type: none"> grip diameter (for handles) max weight of 99th percentile male (for step ladder load bearing) width of feet with shoes on (step width) comfortable lifting height for feet (step spacing) length of foot (to ensure steps do not overhang too much preventing ascent). <p>Accept any other valid responses.</p>	2 marks	AO4 2c

Qu	Part	Marking Guidance	Total marks	AO
06		<p>State the two types of nutrient associated with the circular economy.</p> <p>One mark for each nutrient identified.</p> <p>Indicative content</p> <ul style="list-style-type: none"> Biological nutrients. Technological nutrients. 	2 marks	AO4 2a

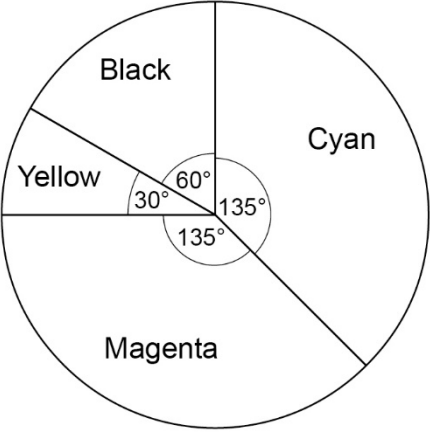
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07		<p>Outline how a manufacturer could personalise a mass-produced product to an individual customer’s requirements.</p> <table border="1" data-bbox="320 439 1217 779"> <thead> <tr> <th data-bbox="320 439 504 472">Marks</th> <th data-bbox="504 439 1217 472">Description</th> </tr> </thead> <tbody> <tr> <td data-bbox="320 472 504 573">5–6 marks</td> <td data-bbox="504 472 1217 573">The response shows a detailed understanding outlining technically accurate techniques used to personalise mass produced products.</td> </tr> <tr> <td data-bbox="320 573 504 674">3–4 marks</td> <td data-bbox="504 573 1217 674">The response shows a good understanding of one or more technique with some relevant detail on how personalisation is achieved.</td> </tr> <tr> <td data-bbox="320 674 504 741">1–2 marks</td> <td data-bbox="504 674 1217 741">The response provides a basic description of how a product may be personalised.</td> </tr> <tr> <td data-bbox="320 741 504 779">0 marks</td> <td data-bbox="504 741 1217 779">No response or nothing worthy of credit.</td> </tr> </tbody> </table> <p>Indicative content</p> <p>The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above.</p> <ul style="list-style-type: none"> • Manufacturers produce products with standardised fittings to allow for a range of alternative features to be added based on customer requirements. • The addition of pigments into standardised forming processes allows for a basic level of personalisation/variety within a product range. • The use of editable standardised computer files/images. • Post-production personalisation through engraving can allow for personalisation of products. • Online applications allow customers to ‘design’ their own products, such as cars, using a predetermined set of options. <p>Examples</p> <ul style="list-style-type: none"> • Coca Cola use digital printing on bottle labels to produce named bottles. • Ikea produce modular furniture ‘systems’ such as PAX etc that allow consumers to build their own wardrobe online through a 3D CAD model and generate a parts list for collection in store. • Personalisation of glassware and other objects that can be etched either by laser or acid etching is an option after purchase of a standard mass-produced product. • Vinyl wrapping is becoming more popular in the vehicle industry, ether for the addition of company decals to the side of a van or for a full wrap in a colour or finish that is not available directly from the manufacturer. • Personalised trainers. • The use of digital printing on flat surface labels allows for the adjustment of images much more readily than through offset lithography where plates would have to be changed. <p>Accept any other valid responses.</p>	Marks	Description	5–6 marks	The response shows a detailed understanding outlining technically accurate techniques used to personalise mass produced products.	3–4 marks	The response shows a good understanding of one or more technique with some relevant detail on how personalisation is achieved.	1–2 marks	The response provides a basic description of how a product may be personalised.	0 marks	No response or nothing worthy of credit.	6 marks	AO4 2b
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08		<p>Explain the benefits of using laser scanning for quality control in mass production.</p> <table border="1" data-bbox="320 439 1217 779"> <thead> <tr> <th data-bbox="320 439 504 472">Marks</th> <th data-bbox="504 439 1217 472">Description</th> </tr> </thead> <tbody> <tr> <td data-bbox="320 472 504 573">5–6 marks</td> <td data-bbox="504 472 1217 573">The response gives a detailed explanation of laser scanning benefits and their relevance to quality control in mass production.</td> </tr> <tr> <td data-bbox="320 573 504 674">3–4 marks</td> <td data-bbox="504 573 1217 674">The response gives a good explanation of laser scanning with some links to quality control and/or mass production.</td> </tr> <tr> <td data-bbox="320 674 504 741">1–2 marks</td> <td data-bbox="504 674 1217 741">The response provides a basic explanation of laser scanning.</td> </tr> <tr> <td data-bbox="320 741 504 779">0 marks</td> <td data-bbox="504 741 1217 779">No response or nothing worthy of credit.</td> </tr> </tbody> </table> <p>Indicative content</p> <p>The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above.</p> <p>Laser scanning:</p> <ul style="list-style-type: none"> • can be done on objects without contact, increasing hygiene • can be done from distance on objects that may be hot after forming • can be directly compared with 3D CAD files through a direct computer link • works to extreme level of accuracy and can measure multiple different measurements rapidly • an expensive but important method for QC in industries with tight dimensional tolerances • non-destructive testing method • results can be fed back into the production line, identifying and feeding back issues instantly. <p>Accept any other valid responses.</p>	Marks	Description	5–6 marks	The response gives a detailed explanation of laser scanning benefits and their relevance to quality control in mass production.	3–4 marks	The response gives a good explanation of laser scanning with some links to quality control and/or mass production.	1–2 marks	The response provides a basic explanation of laser scanning.	0 marks	No response or nothing worthy of credit.	6 marks	AO4 2b
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09		<p>Figure 5 shows some packaging for biscuits.</p> <table border="1" data-bbox="320 398 1214 589"> <thead> <tr> <th data-bbox="320 398 663 450">Component</th> <th data-bbox="663 398 1214 450">Material</th> </tr> </thead> <tbody> <tr> <td data-bbox="320 450 663 501">Box</td> <td data-bbox="663 450 1214 501">Carton board</td> </tr> <tr> <td data-bbox="320 501 663 553">Polymer wrapper</td> <td data-bbox="663 501 1214 553">low density polyethylene (LDPE) film</td> </tr> <tr> <td data-bbox="320 553 663 589">Biscuit tray</td> <td data-bbox="663 553 1214 589">Polyethylene terephthalate (PET)</td> </tr> </tbody> </table> <p>Analyse and evaluate the environmental impact of the three packaging components shown.</p> <p>In your answer you should refer to:</p> <ul style="list-style-type: none"> • raw materials • product manufacture • disposal/end of life. <table border="1" data-bbox="320 931 1214 1375"> <thead> <tr> <th data-bbox="320 931 504 969">Marks</th> <th data-bbox="504 931 1214 969">Description</th> </tr> </thead> <tbody> <tr> <td data-bbox="320 969 504 1104">9–12 marks</td> <td data-bbox="504 969 1214 1104">The response provides detailed analysis and evaluation of all components of the packaging. Reference to materials, manufacture and disposal is made.</td> </tr> <tr> <td data-bbox="320 1104 504 1205">5–8 marks</td> <td data-bbox="504 1104 1214 1205">The response provides a good analysis and some evaluation of the packaging, discussing the key elements of environmental impact.</td> </tr> <tr> <td data-bbox="320 1205 504 1339">1–4 marks</td> <td data-bbox="504 1205 1214 1339">The response provides a basic analysis of the packaging and limited evaluation of the environmental impact focussing mainly on some aspect(s) of the packaging.</td> </tr> <tr> <td data-bbox="320 1339 504 1375">0 marks</td> <td data-bbox="504 1339 1214 1375">No response or nothing worthy of credit.</td> </tr> </tbody> </table> <p>Indicative content</p> <p>The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above.</p> <p>Box:</p> <ul style="list-style-type: none"> • carton board should be produced from FSC timber • printed images are applied by offset lithography printing requiring the addition of inks • printing process uses electrical energy to run printer and produces contaminants that can't be allowed into streams/rivers • addition of foil blocking or spot varnishing adds energy consumption • die cutting of package creates waste carton board that can be recycled but creates contaminants during ink removal • die cutting uses electrical energy during operation • when recycled the adhesive joining the box together adds a contaminant to the process. 	Component	Material	Box	Carton board	Polymer wrapper	low density polyethylene (LDPE) film	Biscuit tray	Polyethylene terephthalate (PET)	Marks	Description	9–12 marks	The response provides detailed analysis and evaluation of all components of the packaging. Reference to materials, manufacture and disposal is made.	5–8 marks	The response provides a good analysis and some evaluation of the packaging, discussing the key elements of environmental impact.	1–4 marks	The response provides a basic analysis of the packaging and limited evaluation of the environmental impact focussing mainly on some aspect(s) of the packaging.	0 marks	No response or nothing worthy of credit.	12 marks	AO3 2a AO3 2b
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		<p>Polymer film wrapper:</p> <ul style="list-style-type: none"> • sourced from a finite resource of crude oil • the clear polymer MUST be produced from ‘virgin’ polymer rather than recycled to give the transparency • the calendaring process to produce the film uses heat and pressure • the joining of the polymer film uses heat to bond the polymer without adding an extra adhesive • LDPE used for the wrapping is a commonly recycled thermoplastic. <p>Vacuum formed tray:</p> <ul style="list-style-type: none"> • sourced from either crude oil or recycled polymer • vacuum forming requires heat and electrical energy • waste polymer is trimmed from trays and recycled for further processing • final recycling possible due to thermoplastic • black colouring can limit recycling possibilities due to difficulty detecting on a conveyor belt. <p>Accept any other valid responses.</p>		
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Qu	Part	Marking Guidance	Total marks	AO
10		<p>State two reasons why a barcode is used on packaging.</p> <p>One mark for each relevant point.</p> <p>Indicative content</p> <p>The guidance provided is illustrative and not exhaustive.</p> <ul style="list-style-type: none"> • To allow for accurate stock monitoring within a store. • To give accurate pricing data for retail and sale. • To allow automatic stock re-ordering via Electronic Data Interchange (EDI). • To allow scanning to be used at checkouts. • To enable product recalls. • To provide a unique identification of products, eg tracking. <p>Accept any other valid responses.</p>	2 marks	AO4 2a



Qu	Part	Marking Guidance	Total marks	AO															
11		<p>Figure 6 represents the coverage of different printing ink colours on some packaging.</p> <p style="text-align: center;">Figure 6</p>  <p>Table 1 shows the cost of different cartridges and the ink areas each cartridge can cover.</p> <p style="text-align: center;">Table 1</p> <table border="1" data-bbox="395 1173 1145 1464"> <thead> <tr> <th>Colour</th> <th>Cartridge cost (£)</th> <th>Surface coverage per cartridge (m²)</th> </tr> </thead> <tbody> <tr> <td>Black</td> <td>10.50</td> <td>8 m²</td> </tr> <tr> <td>Cyan</td> <td>16.00</td> <td>12 m²</td> </tr> <tr> <td>Magenta</td> <td>16.00</td> <td>12 m²</td> </tr> <tr> <td>Yellow</td> <td>16.00</td> <td>12 m²</td> </tr> </tbody> </table> <p>The packaging has a surface area of 0.6 m²</p>	Colour	Cartridge cost (£)	Surface coverage per cartridge (m ²)	Black	10.50	8 m ²	Cyan	16.00	12 m ²	Magenta	16.00	12 m ²	Yellow	16.00	12 m ²		
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Yellow	16.00	12 m ²																	

Qu	Part	Marking Guidance	Total marks	AO
11	1	<p>Show that five yellow cartridges will be needed for 1000 packages.</p> <p>Calculate Yellow as surface area of one package</p> $\frac{30}{360} = \frac{1}{12}$ $\frac{1}{12} \times 0.6 \text{ m}^2$ $= 0.05 \text{ m}^2$ <p>Calculate exact number of yellow cartridges used for 1000 packages</p> $0.05 \times 1000 = 50 \text{ m}^2$ <p>Yellow surface area for 1000 packages</p> <hr/> <p>surface area covered by one yellow cartridge</p> $\frac{50}{12} = 4.166 \text{ cartridges}$ <p>Recognition that five full cartridges are needed</p> <p>As full cartridges are needed then 4.166 is rounded up to 5</p>	3 marks	AO4 2c

Qu	Part	Marking Guidance	Total marks	AO
11	2	<p>Calculate the total cost of full cartridges needed for 1000 packages.</p> <p>Calculate surface areas of other colours for 1 package</p> <p>Black $\frac{1}{6} \times 0.6 = 0.1 \text{ m}^2$ 1 mark</p> <p>Cyan $\frac{3}{8} \times 0.6 = 0.225 \text{ m}^2$</p> <p>Magenta $\frac{3}{8} \times 0.6 = 0.225 \text{ m}^2$</p> <hr/> <p>Calculate number of cartridges needed for each colour to produce 1000 packages</p> <p>Black $0.1 \times 1000 = 100 \text{ m}^2$ 1 mark</p> <p>$\frac{100}{8} = 12.5$ (13)</p> <p>Cyan $0.225 \times 1000 = 225 \text{ m}^2$</p> <p>$\frac{225}{12} = 18.75$ (19)</p> <p>Magenta $0.225 \times 1000 = 225 \text{ m}^2$</p> <p>$\frac{225}{12} = 18.75$ (19)</p> <hr/> <p>Calculate total cost</p> <p>Black $13 \times \text{£}10.50 = \text{£}136.50$ 1 mark</p> <p>Yellow $5 \times \text{£}16 = \text{£}80$</p> <p>Cyan $19 \times \text{£}16 = \text{£}304$</p> <p>Magenta $19 \times \text{£}16 = \text{£}304$</p> <p>Total cost $\text{£}824.50$</p> <hr/> <p>Calculate total cost. Where no working out is shown but final answer is accurate.</p> <p>$\text{£}824.50$ 3 marks</p>	3 marks	AO4 2c

Qu	Part	Marking Guidance	Total marks	AO
12	1	<p>Define the purpose of the RoHS directive.</p> <p>One mark for reference to RoHS preventing/restricting the use of hazardous substances.</p> <p>One mark for an explanation that restriction is to prevent damage to human health.</p>	2 marks	AO4 2a

Qu	Part	Marking Guidance	Total marks	AO
12	2	<p>State two specific materials that are restricted under the RoHS directive.</p> <p>One mark for each material.</p> <p>Indicative content</p> <p>Materials:</p> <ul style="list-style-type: none"> • cadmium • lead • mercury • chromium (hexavalent). 	2 marks	AO4 2a

Qu	Part	Marking Guidance	Total marks	AO
13		<p>Identify the following labels and state what they mean.</p> <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;"> <p>Figure 7</p>  </div> <div style="text-align: center;"> <p>Figure 8</p>  </div> </div> <p>Indicative content</p> <p>Figure 7 One mark for Möbius (Möbius) Loop.</p> <p>One mark for meaning, ie the product can be recycled.</p> <p>Figure 8 One mark for (BSI) Kitemark.</p> <p>One mark for meaning, ie the BSI kitemark assures customers that a product has been tested and is safe and conforms to the relevant British standards for sale in Britain.</p>	4 marks	AO4 2a

Qu	Part	Marking Guidance	Total marks	AO										
14		<p>Outline the impact of the work of Charles and Ray Eames on furniture design.</p> <p>You should refer to specific examples in your answer.</p> <table border="1" data-bbox="320 504 1197 882"> <thead> <tr> <th data-bbox="320 504 504 539">Marks</th> <th data-bbox="504 504 1197 539">Description</th> </tr> </thead> <tbody> <tr> <td data-bbox="320 539 504 674">5–6 marks</td> <td data-bbox="504 539 1197 674">The response provides detailed discussion of the impact of work by Charles and Ray Eames on furniture design, using some specific examples to relate to the work of current styles.</td> </tr> <tr> <td data-bbox="320 674 504 775">3–4 marks</td> <td data-bbox="504 674 1197 775">The response provides a good discussion of work by Charles and Ray Eames referring to techniques/products associated with them.</td> </tr> <tr> <td data-bbox="320 775 504 842">1–2 marks</td> <td data-bbox="504 775 1197 842">The response provides a basic discussion of work by Charles and Ray Eames.</td> </tr> <tr> <td data-bbox="320 842 504 882">0 marks</td> <td data-bbox="504 842 1197 882">No response or nothing worthy of credit.</td> </tr> </tbody> </table> <p>Indicative content</p> <p>The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above.</p> <ul data-bbox="320 1086 1173 1361" style="list-style-type: none"> • Charles and Ray Eames pioneered the forming of moulded plywood furniture. • They also led the way with the construction of single piece fibreglass furniture. • They produced simple one-piece forms in bold colours. • Their work can be seen as influential with Ikea and modern flat pack furniture. • Their work with fibreglass led to the S Chair by Verner Panton. <p>Exemplar response: (top mark band)</p> <p>The Eames's pioneered the forming of moulded plywood furniture seen in the Lounge Chair Wood, (LCW), and Dining Chair Wood, (DCW), and also the construction of fibreglass single piece forms. This has had a huge impact on developments used by Ikea and Verner Panton who developed the S Chair in fibreglass.</p> <p>Accept any other valid responses.</p>	Marks	Description	5–6 marks	The response provides detailed discussion of the impact of work by Charles and Ray Eames on furniture design, using some specific examples to relate to the work of current styles.	3–4 marks	The response provides a good discussion of work by Charles and Ray Eames referring to techniques/products associated with them.	1–2 marks	The response provides a basic discussion of work by Charles and Ray Eames.	0 marks	No response or nothing worthy of credit.	6 marks	AO4 2b
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Qu	Part	Marking Guidance	Total marks	AO
15		<p>Figure 9 shows steel beam supports for a wooden floor.</p> <p>Give two reasons why an I-beam cross section is ideal for the main support.</p> <p>One mark for each relevant point.</p> <p>Indicative content</p> <p>The guidance provided is illustrative and not exhaustive.</p> <ul style="list-style-type: none"> • I-beam section is a common stock form (available in a range of standardised profiles). • I-beam sections reduce weight while maintaining rigidity (compared to solid alternatives). • I-beam sections can be easily fabricated on site (through welding procedures). • I-beam sections allow bolts to be secured through thin flanges (for ease of assembly on site). <p>Accept any other valid responses.</p>	2 marks	AO4 2c