A-level

DESIGN AND TECHNOLOGY: PRODUCT DESIGN 7552/1

Paper 1 Technical Principles

Mark scheme

June 2024

Version: 1.0 Final

246A7552/1/MS

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

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

No student should be disadvantaged on the basis of their gender identity and/or how they refer to the gender identity of others in their exam responses.

A consistent use of 'they/them' as a singular and pronouns beyond 'she/her' or 'he/him' will be credited in exam responses in line with existing mark scheme criteria.

Further copies of this mark scheme are available from aqa.org.uk

Level of response marking instructions

Level of response mark schemes are broken down into levels, each of which has a descriptor. The descriptor for the level shows the average performance for the level. There are marks in each level.

Before you apply the mark scheme to a student's answer read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1 Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

When assigning a level you should look at the overall quality of the answer and not look to pick holes in small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level and then use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 3 with a small amount of level 4 material it would be placed in level 3 but be awarded a mark near the top of the level because of the level 4 content.

Step 2 Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the Indicative content to reach the highest level of the mark scheme.

An answer which contains nothing of relevance to the question must be awarded no marks.

Glossary for maths

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

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

Questions which do not ask students to show working

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

Qu	Part	Marking Guidance	Total marks	AO
01		Give **three** reasons why cellulose acetate is used in packaging. 1 mark for each appropriate reason given. Maximum 3 marks. **Indicative content** • It is a **transparent** material that allows consumers to see products held within the packaging. • It can be **formed into thin sheets** that can then be **successfully die cut**. • It will **naturally biodegrade** reducing its environmental impact when disposed of. • It has a **smooth surface** that allows logos and branding to be **successfully printed**. • It is **non toxic and food safe** so it would be suitable for use with consumable items. • It is **resistant to moisture (Do not accept waterproof)** • It can be **recycled** along with paper based products. **This list is not exhaustive. Accept any other valid responses.**	**3 marks**	AO4 1a

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>02</td><td></td><td>
Analyse and evaluate the suitability of using acrylonitrile butadiene styrene (ABS) for the manufacture of a construction worker's helmet shown in Figure 1.
<table>
<tr><th>Marks</th><th>Description</th></tr>
<tr><td>5–6 marks</td><td>The response includes detailed analysis and evaluation of the suitability of ABS for the manufacture of the helmet. The response makes reference to a range of appropriate factors, mostly relevant to the helmet context.</td></tr>
<tr><td>3–4 marks</td><td>The response includes some good analysis and evaluation of the suitability of ABS for the manufacture of the helmet. The response covers several appropriate factors related to the context but may also include generic benefits of ABS.</td></tr>
<tr><td>1–2 marks</td><td>The response includes basic analysis and tends to be descriptive rather than evaluative.</td></tr>
<tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr>
</table>
Indicative content

Acrylonitrile Butadiene Styrene (ABS)

• Is a lightweight polymer that would make the helmet comfortable for use over extended periods of time.
• Can be easily pigmented in vivid colours that make the worker easily visible on a construction site. It would also enable a range of other colours for different site-specific roles.
• Is a tough material that would maintain its structure and protect the user if impact occurred from falling debris.
• Is a thermoplastic that can be successfully injection moulded into the shape and profile of the construction worker's helmet.
• Is a polymer that will slowly degrade with exposure to UV and may become brittle and not fit for purpose over an extended period of time.
• Is a polymer whose properties can be enhanced by the addition of UV stabilisers that will increase its useful lifespan in an outdoor environment.
• Is impermeable to liquid so will be suitable for outdoor use in all weathers.
• Will absorb heat from the sun which could make the helmet uncomfortable to wear.

This list is not exhaustive. Accept any other valid responses.
</td><td>6 marks</td><td>AO3 2a
AO3 2b</td></tr>
</table>

Qu	Part	Marking Guidance	Total marks	AO
03		Identify the polymer stock form used for the following manufacturing processes. 1 mark for each correct stock form given. **Indicative content** **Injection Moulding** Polymer granules Polymer pellets **Vacuum Forming** Polymer sheet Polymer film **Rotational Moulding** Polymer powder	**3 marks**	AO4 1a

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>04</td><td></td><td>Explain why thermochromatic pigment has been used in the child's forehead thermometer shown in Figure 2.

<table>
<tr><th>Marks</th><th>Description</th></tr>
<tr><td>5–6 marks</td><td>The response shows a detailed and thorough understanding of why thermochromatic pigment has been used. The response identifies and explains several advantages clearly related to the thermometer context. There may be some minor irrelevant points made but this will not detract from the overall quality of the response.</td></tr>
<tr><td>3–4 marks</td><td>The response demonstrates a good understanding of why thermochromatic pigment has been used. The response identifies some benefits related to the thermometer context. There may be some irrelevant points made or a lack of clarity but this will not detract from the overall response.</td></tr>
<tr><td>1–2 marks</td><td>The response offers a basic understanding of why thermochromatic pigment has been used. At the lower end of the mark band statements will be largely generic.</td></tr>
<tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr>
</table>

Indicative content

• Thermochromatic pigment responds to a change in temperature provided by the heat from the user's forehead.
• Thermochromatic pigment changes colour depending on the temperature providing an easy to distinguish visual representation of the temperature on the thermometer.
• The temperature range can be engineered to be appropriate for the thermometer application.
• Thermochromatic pigment is non toxic and safe for an application involving children. It is more appropriate than a traditional mercury thermometer.
• The pigment can be incorporated into the flexible polymer necessary for adapting to the profile of a forehead.
• The pigment requires no power source, so the thermometer will always be ready for use and requires no ongoing aftercare.

This list is not exhaustive. Accept any other valid responses.</td><td>6 marks</td><td>AO4 1b</td></tr>
</table>

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>05</td><td>1</td><td>A sheet of plywood today costs £85. It has increased in price by 38% over the past year.

Calculate the original price of the plywood sheet.

Show your working.

<table>
<tr><td>Establishing the percentage increase</td><td>$\frac{85}{138}$

= 0.61594203</td><td>1 mark (M1)</td></tr>
<tr><td>Calculating the original cost of the sheet</td><td>= [their 0.61594203] × 100

= £61.59

or

$100 \times \left(\frac{85}{138}\right)$

= £61.59</td><td>1 mark (M1)

1 mark (A1)</td></tr>
<tr><td>Combination of first two stages</td><td>$\frac{85}{1.38}$ = 61.5942029

= £61.59 or £61.60</td><td></td></tr>
<tr><td>Cost of original sheet
Where no working has been shown but final answer is accurate.</td><td>= £61.59 or £61.60</td><td>3 marks</td></tr>
</table>
</td><td>3 marks</td><td>AO4 1c</td></tr>
</table>

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>05</td><td>2</td><td>I have a budget of £850 which allows me to buy 10 sheets of plywood.

Calculate how many sheets I would have been able to buy last year with £850.

Show your working.

<table>
<tr><td>Calculating difference in cost</td><td>$\frac{£850}{[\text{their } £61.59]}$

= [their] 13.80 sheets

= 13.80

= 13 sheets

or

10 × 1.38 (established from part a)

= 13.8

= 13 sheets</td><td>1 mark (M1)

1 mark (A1)</td></tr>
<tr><td>Number of additional sheet
Where no working has been shown but final answer is accurate.</td><td>= 13 sheets</td><td>2 marks</td></tr>
</table>
</td><td>2 marks</td><td>AO4 1c</td></tr>
</table>

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>06</td><td></td><td>Describe the process used to create the laser-cut plywood coaster shown in Figure 3.

<table>
<tr><th>Marks</th><th>Description</th></tr>
<tr><td>5–6 marks</td><td>The response covers in detail the required stages in a logical sequence and providing technical detail relating to power and speed that would be needed to produce a successful laser cut coaster product.</td></tr>
<tr><td>3–4 marks</td><td>The response outlines with some detail, most of the main stages of the process, which, if followed, would achieve a successful laser cut coaster. There may be some specific details of the stages missing, but they do not detract from the overall quality of the response.</td></tr>
<tr><td>1–2 marks</td><td>The response outlines the basic stages undertaken to produce the laser cut coaster.</td></tr>
<tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr>
</table>

Indicative content

Create the design
• A computer aided design (CAD) programme would be used to create the design of the coaster.
• A colour would be assigned to the cut elements of the design and an alternative colour to the areas that were to be engraved.

Exporting the file
• The design would be saved, exported and sent in the correct format to the laser cutter.
• An additional piece of software may be needed to process the CAD drawing into the correct file type for the laser cutter.
• The speed and power would be selected in line with the material type, the thickness of material and the desired contrast of the engraved area of the design.
• The power and speed settings may also be determined by the user selecting an appropriate preloaded material profile.

Selecting the material
• A piece of material of sufficient dimensions would be sourced or prepared.
• The thickness of the material may be measured to ensure that its tolerance would allow for a successful cut.

Laser cutting the design
• The material would be placed in the machine at the correct origin.
• The origin may be set to correspond with the material once inserted.</td><td>6 marks</td><td>AO4 1a</td></tr>
</table>

		• The machine should be focused to ensure that the top surface of the material is at the appropriate height for the laser to function correctly. • The design can then be engraved and cut out with the appropriate extraction in place. **This list is not exhaustive. Accept any other valid responses.**		

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>07</td><td>1</td><td>Calculate the total area of the shaded part of the coaster.

Show your working.

<table>
<tr><td>Area of shaded triangle</td><td>$\frac{b \times h}{2}$

$\frac{50 \times 40}{2}$

= 1000 mm^2</td><td>1 mark (M1)</td></tr>
<tr><td>Area of shaded trapezium</td><td>= $\frac{(35 + 50)}{2} \times 38$

=1615 mm^2</td><td>1 mark (M1)</td></tr>
<tr><td>Total area of shaded engraved shape</td><td>Area of triangle + Area of trapezium

1000 + 1615

= 2615 mm^2</td><td>1 mark (A1)</td></tr>
<tr><td>Total area of shaded engraved shape
Where no working has been shown but final answer is accurate.</td><td>= 2615 mm^2</td><td>3 marks</td></tr>
</table>
</td><td>3 marks</td><td>AO4 1c</td></tr>
</table>

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>07</td><td>2</td><td>Calculate the total time taken to engrave the shaded part of the coaster and to cut the circumference.

Show your working.

<table>
<tr><td>Time taken to engrave shape</td><td>Time = $\frac{\text{area}}{\text{speed}}$

Their $\frac{2615}{59}$

Or

44.32 secs</td><td>1 mark (M1)</td></tr>
<tr><td>Circumference of the circle</td><td>$c = 2\pi r$

$= 2 \times \pi \times 55$

= [345.4, 345.62] mm</td><td>1 mark (M1)</td></tr>
<tr><td>Time taken to cut circumference of coaster</td><td>Time = $\frac{\text{distance}}{\text{speed}}$

= $\frac{Their[345.4,\ 345.62]}{8}$

= Their [43.17, 43.20] secs

= 44.32 + [43.17, 43.20]</td><td>1 mark (M1)</td></tr>
<tr><td>Total time taken</td><td>= [87.49, 87.52]</td><td>1 mark (A1)</td></tr>
<tr><td>Total time taken
Where no working has been shown but final answer is accurate.</td><td>= [87.49, 87.52] secs</td><td>4 marks</td></tr>
</table>
</td><td>4 marks</td><td>AO4 1c</td></tr>
</table>

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>08</td><td></td><td>Describe why pewter is often used for casting in a school workshop.

<table>
<tr><th>Marks</th><th>Description</th></tr>
<tr><td>5–6 marks</td><td>Detailed understanding of why pewter is used for casting in a school environment. Response may refer to the properties of the material, mould manufacture and be clearly related to the considerations appropriate to a school environment.</td></tr>
<tr><td>3–4 marks</td><td>Some good understanding of why pewter is often used for casting in a school environment. Response may make some reference to the properties of the material and the considerations appropriate to a school environment.</td></tr>
<tr><td>1–2 marks</td><td>Limited understanding of why pewter is used for casting in a school environment. Response tends to give generic statements.</td></tr>
<tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr>
</table>

Indicative content

• Pewter has a relatively low melting point (250 °C) that can be achieved safely in a school workshop using a hot air gun, brazing torch or low temperature casting crucible.
• There is no need for extensive hot metal facilities unlike casting with other metals.
• The low temperature of the molten metal allows for a range of materials and common workshop tools and machinery to be used to produce the moulds.
• Pewter is a malleable material that can be easily finished and polished to achieve a high-quality finish.
• Pewter has a low viscosity so that it can successfully flow into thin mould cavities.
• Pewter moulding is a fast process, cooling quickly and with minimal setup time, so can be successfully undertaken within a short period of time such as a lesson.
• Pewter can be reheated and reused making it especially suitable for use in a school environment where cost and waste are important factors.

This list is not exhaustive. Accept any other valid responses.</td><td>6 marks</td><td>AO4 1b</td></tr>
</table>

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>09</td><td></td><td>Explain why Plastazote foam is an appropriate material for the manufacture of the exercise mat shown in Figure 5.

<table>
<tr><th>Marks</th><th>Description</th></tr>
<tr><td>5–6 marks</td><td>The response includes detailed understanding of why Plastazote Foam would be a suitable material for the exercise mat. Response should refer to the physical and mechanical properties of Plastazote Foam and be specifically related to the exercise mat context. Not all indicative content needs to be referenced to access full marks.</td></tr>
<tr><td>3–4 marks</td><td>The response includes good understanding of why Plastazote Foam would be a suitable material for the exercise mat. Response may refer to the physical or mechanical properties of Plastazote Foam and its suitability for the exercise mat context. There may be some irrelevant points made or a lack of clarity but this will not detract from the overall quality of the response.</td></tr>
<tr><td>1–2 marks</td><td>The response offers a basic explanation of the material properties of Plastazote Foam with limited reference to the exercise mat application. At the lower end of the mark band statements will be largely generic.</td></tr>
<tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr>
</table>

Indicative content

• Plastazote foam is flexible and lightweight allowing it to be rolled up and carried to and from an exercise class.
• Plastazote foam has excellent thermal properties meaning that it is comfortable to use on a cold gym floor surface.
• Plastazote foam is impermeable to liquids meaning that it will not absorb sweat and can be easily wiped down after use.
• Plastazote foam has good chemical resistance so it can be cleaned with detergents to maintain a hygienic product.
• Plastazote foam has a closed cell construction that can be compressed to provide a comfortable surface on which to exercise.
• Plastazote foam can be pigmented to allow consumer aesthetic choice and to enable successful company branding.
• Plastazote foam can be cut and formed easily into the desired shape of the exercise mat.
• Plastazote foam is tough so will not be damaged if heavy weights or fitness equipment is placed on it.

This list is not exhaustive. Accept any other valid responses.</td><td>6 marks</td><td>AO4 1c</td></tr>
</table>

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>10</td><td></td><td>
Compare the following joining methods for attaching two thin sheets of aluminium:

• pop rivets
• nuts and bolts.

<table>
<tr><th>Marks</th><th>Description</th></tr>
<tr><td>5–6 marks</td><td>The response shows detailed analysis and clear understanding of each of the joining methods. The response compares and evaluates how appropriate each joining method would be and may provide advantages and disadvantages for each for the thin sheet context.</td></tr>
<tr><td>3–4 marks</td><td>The response shows a good understanding of each of the joining methods and suggests appropriate advantages and disadvantages of each. The response makes reference to the thin sheet context, but may still include some general points.</td></tr>
<tr><td>1–2 marks</td><td>Basic evaluation of each of the joining methods. The response shows a basic understanding of each joining method, but lacks specific detail for the thin sheet context.</td></tr>
<tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr>
</table>

Indicative content

Pop rivets

Advantages
• Pop rivets are fitted from one side, so there is no need to access the rear of the pop rivet.
• The head of the rivet has a low profile that would not stand out from the surface of the aluminium too far.
• Pop rivets are made from aluminium so will not corrode.
• A pop rivet is a permanent joining method.

Disadvantages
• The pop rivets require a special tool in order to install them successfully.
• If the aluminium sheets need to be taken apart, the rivet can be drilled out, but will not be able to be used again, some damage may occur to the aluminium during this process.
• The back of the rivet can be unsightly.
</td><td>6 marks</td><td>AO3 2a
AO3 2b</td></tr>
</table>

		Nuts and bolts **Advantages** • Nuts and bolts can be fitted and removed with no reduction in the integrity of the joint. • The nut and bolt could be tightened to a specific torque. • Nuts are available with a range of specific functions such as 'Nyloc' or 'Domed heads'. • There is a wide range of head style for the nuts depending on the application. • A nut and bolt fastening can be temporary and removed or adjusted if necessary. **Disadvantages** • A nut and bolt would add significant thickness to the aluminium sheet at the point of joining. • A nut and bolt may work itself loose if the aluminium sheet is exposed to vibrations. • Access is needed to both sides of the aluminium sheet to tighten the nut and bolt. • If the nuts and bolts are manufactured from stainless steel, they may cause a chemical reaction that affects the aluminium. **This list is not exhaustive. Accept any other valid responses.**		

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>11</td><td></td><td>Explain the benefits of a manufacturing simulation when making a component on a CNC router.

<table>
<tr><th>Marks</th><th>Description</th></tr>
<tr><td>5–6 marks</td><td>The response shows a detailed and thorough understanding of manufacturing simulation and the benefits that it can provide. The response identifies and explains several features of machining simulations relating to the uses of a CNC router. There may be some minor irrelevant points made but this will not detract from the overall quality of the response.</td></tr>
<tr><td>3–4 marks</td><td>The response demonstrates a good understanding of manufacturing simulation and the benefits that it can provide. The response identifies some features of simulation relating to the use of a CNC router. There may be some irrelevant points made or a lack of clarity but this will not detract from the overall quality of the response.</td></tr>
<tr><td>1–2 marks</td><td>The response offers a basic understanding of the benefits of a manufacturing simulation. At the lower end of the mark band statements will be largely generic.</td></tr>
<tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr>
</table>

Indicative content

• A simulation would give a graphical representation of the planned machining process and enable the user to check whether the outcome of the process looks as expected.
• A simulation would provide the user with a projected machining time to enable them to plan how to order jobs or use a machine in the most time efficient manner.
• A simulation could provide confirmation that a piece of material is of sufficient size to successfully fit the design or pattern.
• A simulation would help the user identify any potential issues such as tool collisions or sequence of machining processes and allow them to edit the CAD drawing before wasting material and time.
• A simulation would provide the user with information regarding the size of cutter that would need to be installed in the machine or fitted at appropriate points during the machining, allowing them to ensure that the correct resources were in place before machining commenced.
• A simulation would provide confirmation that a piece of material is of sufficient size to successfully fit the design or pattern avoiding a potential waste of material and unnecessary cost.

This list is not exhaustive. Accept any other valid responses.</td><td>6 marks</td><td>AO4 1c</td></tr>
</table>

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>12</td><td></td><td>
Figure 6 shows a torch body and battery.

The volume of the battery is 30 772 mm^3

The length of the battery is 50 mm

The wall thickness of the torch body is 3 mm

Calculate the external diameter of the torch body, assuming that the battery fits exactly.

<table>
<tr><td>Diameter of battery from volume</td><td>$30\ 772 = \pi \times 50 \times r^2$</td><td>1 mark (M1)</td></tr>
<tr><td></td><td>$r = \left(\frac{30\ 772}{(\pi \times 50)}\right)$

$r = \sqrt{\left(\frac{30\ 772}{(\pi \times 50)}\right)}$

r = [13.99, 14] mm

diameter = [13.99, 14] × 2

= [27.98, 28] mm</td><td>1 mark (M1)

1 mark (A1)</td></tr>
<tr><td>External diameter of the torch</td><td>Diameter of battery + wall thickness

= [27.98, 28] + (3 × 2)

= [33.98, 34] mm</td><td>1 mark (A1)</td></tr>
<tr><td>External diameter of the torch
Where no working has been shown but final answer is accurate.</td><td>= [33.98, 34] mm</td><td>4 marks</td></tr>
</table>
</td><td>4 marks</td><td>AO4 1c</td></tr>
</table>

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>13</td><td></td><td>
Figure 7 and Figure 8 show dishwashing accessories.
<table>
<tr><th></th><th>Figure 7</th><th>Figure 8</th></tr>
<tr><td>Method of manufacture</td><td>Injection moulded</td><td>Blow moulded</td></tr>
<tr><td>Handle texture</td><td>Over moulded with a Thermoplastic Elastomer (TPE)</td><td>Integrated during the moulding process</td></tr>
</table>
Analyse and evaluate the method of manufacture used to create each of the textured surfaces on the two handles.
<table>
<tr><th>Marks</th><th>Description</th></tr>
<tr><td>5–6 marks</td><td>The response shows detailed analysis of each manufacturing method used to create each handle texture. The response evaluates the appropriateness of each manufacturing method with reference to the stages of manufacture and the opportunities each technique provides the manufacturer.</td></tr>
<tr><td>3–4 marks</td><td>The response shows good analysis of each manufacturing method used for creating each handle texture. Response provides some evaluation relating to stages of manufacture and the opportunities each technique provides the manufacturer.</td></tr>
<tr><td>1–2 marks</td><td>Basic evaluation of each manufacturing method but response tends to be descriptive rather than evaluative and may focus on only one of the handles.</td></tr>
<tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr>
</table>
Indicative content

Figure 7 – over moulded handle

Injection moulding the component in two stages would allow for two materials to be successfully used in the production of the handle, allowing the manufacturer to select materials with different properties.
The manufacturing process would require two separate moulds to be produced or the use of a specialist injection mould capable of using two materials (dual shot injection moulding. This would increase the initial set up costs of manufacture.
The over moulded section is hard to remove from the main handle, so would make the product difficult to separate into separate materials at the end of its life.

</td><td>6 marks</td><td>AO3 2a
AO3 2b</td></tr>
</table>

		• The over moulding process would allow the manufacturer to use materials with contrasting pigments which may allow for successful branding or aesthetic variation. **Figure 8 – integrated in mould** • As textured is integrated in the mould **no additional stages of manufacture are necessary.** • The single material nature of the handle allows for the product to be recycled more easily at the end of its life. • The texture can successfully be incorporated into the curved profile of the handle. • The texture of the surface is not affected by the thin wall section that would be created during the blow moulding process. • The texture will always be the same colour as the body of the handle, so will allow for limited branding opportunities, but can also be transparent, so does not affect the ability to see the detergent. • The process of adding the texture to the surface of the blow moulding tool would add to the cost of mould production. **This list is not exhaustive. Accept any other valid responses.**		

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>14</td><td></td><td>Describe the techniques a company may use throughout design and manufacture to reduce material waste.

<table>
<tr><th>Marks</th><th>Description</th></tr>
<tr><td>5–6 marks</td><td>The response shows a detailed understanding of the techniques that a company may use to ensure that they are using materials efficiently in both design and manufacture. The response may refer to a variety of techniques and clearly describes how they would impact efficiency. There may be some minor irrelevant points made but this will not detract from the overall quality of the response.</td></tr>
<tr><td>3–4 marks</td><td>The response shows a good understanding of the techniques that a company may use to ensure that they are using materials efficiently. The response may refer to only one area and there may be some generic suggestions made or a lack of clarity but this will not detract from the overall quality of the response.</td></tr>
<tr><td>1–2 marks</td><td>The response offers a basic understanding of the techniques that a company may use to ensure that they are using materials efficiently. At the lower end of the mark band statements will be largely generic.</td></tr>
<tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr>
</table>

Indicative content

Throughout design
• CAD software could be used to ensure accuracy and subsequently enable the use of CNC manufacture.
• CAD software could be used to calculate the most efficient layout of material to be cut from a given size, such as nesting a design for CNC routing.
• FEA modelling could be used to establish the optimum profile or wall thickness etc of a component, allowing for a reduction in the volume of material used.
• Stock forms, profiles and bought in components could be considered at the design stage to reduce the amount of bespoke component manufacture.

Throughout manufacture
• The options for manufacture should be considered to see if a more efficient process such as redistribution could be used instead of wastage processes.
• Processes such as laser cutting may be considered that have a narrow cut path than a rotating tool on routers or milling machines.</td><td>6 marks</td><td>AO4 1b</td></tr>
</table>

		• Consider how **excess and waste material can be collected**, **recycled and reused**, such as polymer and metal waste. • Ensure that machinery is correctly calibrated to minimise faults within the manufacturing process. • They may look to incorporate **the use of manufacturing aids** such as cutting jigs to **ensure accuracy is achieved** each and every time to minimise wastage. • The **layout of jobs should be tessellated** to make the **most efficient use of the available material**. **This list is not exhaustive. Accept any other valid responses.**		

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>15</td><td></td><td>
Figure 9 shows a pie chart that gives information about consumer activities relating to sustainability.

The number of people who said that they reuse a product is 350.

Three times as many people said that they have reduced their consumption to the amount that reuse a product.

Calculate the number of consumers that recycle on a regular basis.

Show your working.

<table>
<tr><td>Calculate total no that reduce their consumption</td><td>Reduce = 3 × Reuse

Reduce = 3 × 350

Reduce = 1050 people</td><td>1 mark (M1)</td></tr>
<tr><td>Calculate angle of reduce and reuse</td><td>= 360° – 120° – 40°

= 200°</td><td>1 mark (M1)</td></tr>
<tr><td>Establish how many people are represented in total</td><td>200° = Reduce and Reuse

200° = 1050 + 350

200° = 1400 people

$\frac{1400}{200} \times 360$

= 2520</td><td>1 mark (M1)</td></tr>
<tr><td>Establish how many people recycle</td><td>$\frac{2520}{360} \times 120$

= 840 people</td><td>1 mark (A1)</td></tr>
<tr><td>Number of people who recycle
Where no working has been shown but final answer is accurate.</td><td>= 840 people</td><td>4 marks</td></tr>
</table>
</td><td>4 marks</td><td>AO4 1c</td></tr>
</table>

Qu	Part	Marking Guidance	Total marks	AO
16		State **four** measures that an employer may consider to ensure that they are meeting the Health and Safety at Work Act (1974). One mark per appropriate measure or activity. Maximum of 4 marks. **Indicative content** The employer should ensure that: • risk assessments have been undertaken and acted upon in order to reduce the employee's exposure to activities, materials or substances that may be harmful. • training is received and kept up to date. • machinery is maintained and inspected regularly. • extraction systems are in place, tested and maintained to limit exposure to dust. • staff are trained on the correct use of PPE. • noise and lighting levels are appropriate and monitored. • hazard demarcation is present on the flooring. • machine guards are in place. Reference to PPE give a maximum of 1 mark. **This list is not exhaustive. Accept any other valid responses.**	**4 marks**	AO4 1a

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>17</td><td></td><td>
Figure 10 and Figure 11 show cookbook stands.
<table>
<tr><th></th><th>Figure 10</th><th>Figure 11</th></tr>
<tr><td>Material</td><td>Cast Iron</td><td>Medium Density Fibreboard (MDF) and Beech</td></tr>
<tr><td>Method of Manufacture</td><td>Sand Casting</td><td>CNC router and hand fabrication</td></tr>
</table>
Analyse and evaluate the two cookbook stands.

In your answer you should refer to:

• the materials used
• the manufacturing methods used.

<table>
<tr><th>Marks</th><th>Description</th></tr>
<tr><td>9–12 marks</td><td>The response shows a detailed analysis and evaluation of the suitability of the chosen material and manufacturing process of both cook book stands. The response clearly evaluates how the properties of the material and the way in which the stands are manufactured affect the suitability for the cook book context. Not all indicative content needs to be referenced or all four elements of the question to access this top mark band.</td></tr>
<tr><td>5–8 marks</td><td>The response shows good evaluation and analysis of the suitability of the chosen material and manufacturing process of both cook book stands, with appropriate reference to the cook book context. There may be some irrelevant points made or lack of clarity but this will not detract from the overall quality of the response.</td></tr>
<tr><td>1–4 marks</td><td>Basic evaluation of the suitability of the chosen material and manufacturing process of each of the cook book stands, but response tends to be descriptive rather than evaluative or focuses on one material or manufacturing process only.</td></tr>
<tr><td>0 marks</td><td>No response worthy of credit.</td></tr>
</table>
Indicative content

Cast iron

• Cast iron is a dense material meaning that the cook book stand will be heavy. This will make it stable when in use, but also make it hard to move.
</td><td>12 marks</td><td>AO3 2a
AO3 2b</td></tr>
</table>

		• Cast iron is a hard material that may scratch the kitchen worksurface or tablet, depending on material. • Cast iron is a brittle material so may break if the cookbook stand is dropped. **Sand casting** • Sand casting is one of the few manufacturing processes that can be used to form metals such as cast iron that have a high melting point. • Sand casting is best suited to batch production, which would be appropriate to the market demand of the cookbook stand. • Sand casting would need a series of secondary finishing processes such as removing sprues. • The design of the base is fairly basic and the thickness of book stand component is sufficient enough to be achieved by sand casting. • Sand casting can leave a rough surface finish on the cast component which would affect the quality of the product, but may contribute to the rustic aesthetic of the book stand. **Beech** • Beech is a hardwood with a tight grain meaning that it will not easily chip or splinter during use or storage, it will also maintain the sharp angle where is comes in contact with the work surface. • Beech is a durable material which will resist the damage associated with regular use and storage in a kitchen. • Beech is hard, meaning that the surface will resist scratching and abrasion maintaining its attractive aesthetic. • Beech is a common timber found in kitchen products, so may match the aesthetics of existing products. **MDF** • The MDF is a stable flat material that will provide a good surface for resting the cookbook. • MDF can be sealed and painted to provide a high-quality surface finish that is suitable for the aesthetics of a modern kitchen. • If the paint becomes damaged the MDF may absorb moisture when being cleaned and degrade rapidly. **CNC router and hand fabrication** • CNC routing is an appropriate manufacturing process for machining both the external and internal profile of the MDF component. • CNC routing will produce a product of consistent quality and accuracy that will enable the beech components to be fitted accurately.		

		• The radius and the chamfer on the beech components could be easily achieved using an appropriately shaped router cutter. • The thickness of the MDF and beech is suitable to be successfully machined using a router. **This list is not exhaustive. Accept any other valid responses.**		

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>18</td><td></td><td>Discuss the implications to a company of rebranding.

<table>
<tr><th>Marks</th><th>Description</th></tr>
<tr><td>7–9 marks</td><td>A detailed and thorough understanding of a range of implications to a company of rebranding. The response clearly identifies a range of possible positive and negative impacts to the company.</td></tr>
<tr><td>4–6 marks</td><td>The response demonstrates a good understanding of several implications to a company of rebranding. Several relevant points relating to the impact to the company are made.</td></tr>
<tr><td>1–3 marks</td><td>The response offers a basic understanding of the implications to a company of rebranding. The response tends to provide generic statements with limited reference to the impact to the company.</td></tr>
<tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr>
</table>

Indicative content

• The company may already have extensive brand loyalty and a change in logo may not appeal to existing customers.
• They may risk losing their current customer base by no longer being familiar and instantly recognisable.
• The existing company logo will be established in the marketplace and consumer purchasing habits may be altered by amending the logo as products may look different on the shelf.
• There would be a huge cost involved in the development of a new brand logo and also the associated costs of reproducing all stock, stationery, advertising and packaging etc that featured the old logo.
• There would be a period of transition where identical products in the marketplace may have different branding which may confuse customers.
• It could lead to the company having to reduce the cost of products, as they would become instantly dated when the new logo was launched.
• The new logo would be an opportunity for a new marketing campaign and may attract customers that were not familiar with the old brand.
• The modernising of the logo would allow the company to remain up to date and to portray a successful company image that is happy to invest moving forward.
• The new logo may be an opportunity to come in line with the styling of other successful brands and ensure that the company brand didn’t become dated.</td><td>9 marks</td><td>AO4 1b</td></tr>
</table>

		This list is not exhaustive. Accept any other valid responses.		

Qu	Part	Marking Guidance	Total marks	AO
19	**1**	**Figures 12**, **13** and **14** show graphical representations of material testing processes. For each testing process, identify the material property being tested. **Figure 12** • Tensile Strength • Tensile Testing • Tensional Force	**1 mark**	AO4 1a

Qu	Part	Marking Guidance	Total marks	AO
19	**2**	For each testing process, identify the material property being tested. **Figure 13** • Hardness	**1 mark**	AO4 1a

Qu	Part	Marking Guidance	Total marks	AO
19	**3**	For each testing process, identify the material property being tested. **Figure 14** • Toughness • Impact Resistance	**1 mark**	AO4 1a

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>20</td><td></td><td>Explain why the screen printing process is suitable for a low volume production run.

<table>
<tr><th>Marks</th><th>Description</th></tr>
<tr><td>5–6 marks</td><td>The response shows a detailed and thorough understanding of why the screen printing process is suitable for a low volume production run. The response identifies and explains several features of the screen printing process with a clear understanding of how they relate to the volume of production. There may be some minor irrelevant points made but this will not detract from the overall quality of the response.</td></tr>
<tr><td>3–4 marks</td><td>The response demonstrates a good understanding of why the screen printing process is suitable for a low volume production run. The response identifies features of the process and explains how these relate to the volume of production. There may be some irrelevant points made or a lack of clarity but this will not detract from the overall quality of the response.</td></tr>
<tr><td>1–2 marks</td><td>The response offers a basic understanding the screen printing process with limited reference to low volume production. At the lower end of the mark band statements will be largely generic.</td></tr>
<tr><td>0 marks</td><td>No response worthy of credit.</td></tr>
</table>

Indicative content

• Screen printing has minimal setup costs due to the small amount of basic machinery and printing screens needed.
• The process of screen printing requires little automation and is better suited to a worker undertaking the printing process manually.
• The individual screens can be created quickly in response to the needs of different designs.
• Screens can be cleaned and reused making it suitable for revisiting production should an additional number of units need printing.
• Each colour on a design would need a different screen to be used increasing the time taken to produce each unit, limiting the speed and volume of manufacture.
• Each colour ink must dry before the next colour can be printed, limiting the rate of production and highlighting a need for drying space, both factors affecting the volume of production feasible.

This list is not exhaustive. Accept any other valid responses.</td><td>6 marks</td><td>AO4 1b</td></tr>
</table>

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>21</td><td></td><td>Explain the factors that should be considered before forming a curved piece of timber by steam bending.

<table>
<tr><th>Marks</th><th>Description</th></tr>
<tr><td>5–6 marks</td><td>The response shows a detailed understanding of the limitations and considerations that may be taken before steam bending. There may be reference to several key factors including limitations of size and shape along with a detailed understanding of the forming process.</td></tr>
<tr><td>3–4 marks</td><td>The response demonstrates a good understanding of the limitations and considerations of the steam bending process.</td></tr>
<tr><td>1–2 marks</td><td>The response offers a basic understanding of the steam bending process.</td></tr>
<tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr>
</table>

Indicative content

• There will be a limit to the size of the cross section of timber that can be successfully steamed and formed.
• The timber selected will need to be free from knots and shakes in order to be bent successfully.
• Steam bending will use a single piece of timber which limits the complexity and how tight of a curve can be produced.
• Steam bending requires the use of a steam box to make the timber pliable. The size of the bend needed would be governed by the size of the steam box available.
• It can require considerable force to form the timber around the former.
• Steam bending is a time-consuming process due to the timber needing to be soaked, steamed and then dried.
• The formed piece of timber will need to be held in place for a substantial period of time while it dries.
• The former will need to be designed allowing for a little ‘spring back’ when the timber is unclamped.
• Several formed pieces may need to be combined if a larger section component is required.
• For tighter bends an external former may be needed to prevent the outside surface splitting.
• The formed piece of timber would need finishing and cutting to size once formed.

This list is not exhaustive. Accept any other valid responses.</td><td>6 marks</td><td>AO4 1b</td></tr>
</table>