GCSE
DESIGN AND TECHNOLOGY
8552/W

Unit 1 Written Paper

Mark scheme

June 2021

Version: 1.0 Final

216G8552/W/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.

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		**C** Kevlar	1 mark	AO4 1a

Qu	Part	Marking Guidance	Total marks	AO
02		**D** Fashion	1 mark	AO4 1a

Qu	Part	Marking Guidance	Total marks	AO
03		**D** Reducing waste	1 mark	AO4 1a

Qu	Part	Marking Guidance	Total marks	AO
04		**D** Thermal conductivity	1 mark	AO4 1c

Qu	Part	Marking Guidance	Total marks	AO
05		**B** Oscillating	1 mark	AO4 1a

Qu	Part	Marking Guidance	Total marks	AO
06		**B** MDF expands when it absorbs water	1 mark	AO4 1a

Qu	Part	Marking Guidance	Total marks	AO
07		**C** Virtual marketing	1 mark	AO4 1a

Qu	Part	Marking Guidance	Total marks	AO
08		**A** Corrugated card	1 mark	AO4 1c

Qu	Part	Marking Guidance	Total marks	AO
09		**C** Reacts to a stimulus	1 mark	AO4 1a

Qu	Part	Marking Guidance	Total marks	AO
10		**C** Plywood	1 mark	AO4 1a

Qu	Part	Marking Guidance	Total marks	AO
11		One mark for each correct reason why blended and mixed fibres are used in clothing. Credit a specific example if used to support a reason. **Indicative content** The guidance provided is illustrative and not exhaustive. Typical basic responses: • to produce different fibres with more desirable/enhanced properties • improve durability in the fibre • make fabric easier to care for • make clothing less likely to shrink or crease. You may see more detailed responses: • to produce different fibres with more desirable/enhanced properties, eg polyester can mitigate against shrinkage, creasing and slower drying speed • make a yarn (blend of two or more fibres) to make a better product • improve durability in the fibre, eg poly-cotton (polyester and cotton mix) • produce clothing more cheaply, eg poly-cotton is a cheaper material than pure cotton • use of cotton with a synthetic material makes it more breathable hence comfortable to wear • fabrics can be heat-set, eg trousers with a crease, anti-crease fabrics • similar appearance to natural materials, eg cotton, and can accept a print or dye easily. Accept all other valid responses.	2 marks	AO4 1b

<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>
<table>
<tr><td>3 marks</td><td>A range of detailed disadvantages identified with clarity, showing knowledge of issues associated with the extraction of fossil fuels as a source of energy.</td></tr>
<tr><td>2 marks</td><td>Disadvantages identified in brief when extracting fossil fuels as an energy source.</td></tr>
<tr><td>1 mark</td><td>One correct simple disadvantage given.</td></tr>
<tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr>
</table>
Indicative content

The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above.

• Mining of coal produces lots of waste (slag heaps) and pollution (of water courses).
• Visual pollution associated with open cast mining, location of power plants near rivers (water needed for cooling).
• Pollution associated with extraction of fossil fuels deep in the ground leads to atmospheric pollution.
• Shale gas extracted by pumping pressurised water and chemicals deep into the ground is believed to cause earthquakes/seismic shocks and damage to water courses.
• Drilling for oil can lead to pollution of marine ecosystems and pollution, eg Deepwater Horizon disaster in 2010 in the Gulf of Mexico.

Accept all other valid responses.
</td><td>3 marks</td><td>AO4 1b</td></tr>
</table>

Qu	Part	Marking Guidance	Total marks	AO
13	1	1 mark: 0.45×50 $22.5 \div 4$ or 5.625 1 mark: Their number rounded up **(Correct answer = 6 full tins)** or 1 mark: $50 \div (4 \div 0.45)$ or 5.625 1 mark: Their number rounded up **(Correct answer = 6 full tins)**	2 marks	AO4 1c

Qu	Part	Marking Guidance	Total marks	AO
13	2	1 mark: their 5.625 ÷ their 6 (= 0.9375) or their 6 - their 5.625 (= 0.375 of a tin unused) 1 mark: 100 × their 0.9375 (= 93.75% used) or their 0.375 ÷ their 6 (= 0.0625) 1 mark: **Waste is**: 100 - their 93.75 = 6.25% or their 0.625 × 100 = 6.25% Note Where candidates have arrived at a different answer to 5.625 in question 13.1 and used it correctly in 13.2, all marks are still available for the method and answer. Do **not** penalise for not using 5.625 if working and final answer are correct.	3 marks	AO4 1c

Qu	Marking Guidance (Stem – see MS below for actual marks)	

14

Product	Specific main material	Property of the material	Why is the property needed for the product to function properly?
 Mail packaging	Corrugated cardboard	• Lightweight • Impact resistance • Thermal protection	• Does not add to package weight significantly. • Protection against penetration.
 Baseball bat	• Ash • Hickory	• Tough • Durable • Springy wood	Prevents excessive marking due to ball impact.
 Screwdriver blade	• Steel • Chrome vanadium steel • High carbon steel	• Hardness • Durability	Ability to turn a screw head without stripping screwdriver tip.
 Baby's drinking cup	• Polypropylene • Polycarbonate • Melamine	• Heat resistant • Moisture resistant • Soft touch polymer	• Dishwasher safe. • Non-reactive – does not taint food. • Resist knocks and impacts. • Scratch resistant. • Soft so not hard on baby's gums.
 Gym wear	• Cotton • Nylon • Nylon microfibre • Polyester • Polyester microfibre • Knitted fabric	• Breathable • Lightweight • Wear resistant • Durability • Flexibility • Washable	• Comfortable to wear – hugs the body. • Improved long term performance after washing. • Stretchy, dries quickly (not for cotton), crease resist (not for cotton).
 Electronic device with display	Liquid Crystal Display (LCD) or Light-emitting Diode (LED)	Conductivity	Liquid crystals respond electronically to emit light.

Accept other valid responses.

Qu	Part	Marking Guidance	Total marks	AO
14	1	**See table at 14** **Indicative content** **Specific main material** 1 mark – Correctly named material. 0 mark – No response or nothing worthy of credit.	1 mark	AO4 1c

Qu	Part	Marking Guidance	Total marks	AO
14	2	**See table at 14** **Indicative content** **Property of material** 1 mark – Correctly named property. **Award even if specific main material is incorrect or not given in first column. DO NOT double penalise**. 0 mark – No response or nothing worthy of credit.	1 mark	AO4 1c

Qu	Part	Marking Guidance	Total marks	AO
14	3	**See table at 14** **Indicative content** **Why is property needed for product to function?** 2 marks – One detailed description of property or two points in brief of correct component usage. **Credit even if property is incorrect or not given in second column but understanding is correct. DO NOT double penalise**. 1 mark – One brief correct point. 0 marks – No response or nothing worthy of credit. The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above.	2 marks	AO4 1c

<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>
A maximum of two marks for each different way described.
<table>
<tr><td>2 marks</td><td>Two simple points of explanation given or one clarified in greater detail. Clarification is possible using an example.</td></tr>
<tr><td>1 mark</td><td>A simple correct point of explanation given.</td></tr>
<tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr>
</table>
Indicative content

The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above.
<table>
<tr><td>Bending</td><td>Bending materials in a curve can stiffen and strengthen a structure, eg bridge or metal tube chair, reducing the need for too many joints.</td></tr>
<tr><td>Boss</td><td>Additional raised of thickened metal feature used where a threaded part needs to be used.
Provides additional material to accommodate a screw thread where needed rather than using a uniformly thicker piece of material adding weight and cost.</td></tr>
<tr><td>Fillets</td><td>A curved radius on a formed polymer or metal structure or component, eg casting of injection moulding. The radius (fillet) strengthens the point of direction change in the material, eg where two sides meet. They reduce stress concentrations.</td></tr>
<tr><td>Folding</td><td>Can add strength, impact resistance, eg corrugated cardboard as well as flexibility.</td></tr>
<tr><td>Interfacing or Vilene (brand name)</td><td>Sewing or ironing additional layers of fabric where they are usually unseen to strengthen and add stiffness, eg shirt cuffs and collars, hats.
Quilting would be another method of re-enforcing textiles as would piping.</td></tr>
<tr><td>Lamination</td><td>Building up a material in layers forming a composite constriction, eg plywood, CFRP. This increases strength, resistance to shock and impact, rigidity and moisture resistance in some cases, eg polymer cover to a cardboard/paper menu in a restaurant.</td></tr>
<tr><td>Webbing</td><td>Additional material added (webs) to stiffen polymer chair underframes to resist excessive bending and deformation when loaded.</td></tr>
</table>
Accept other valid responses, eg triangulation – used in structures like bridges to make them stiffer and more resistant to dynamic forces.
‘Additional reinforcement’ accepted too.
</td><td>2 × 2 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>16</td><td>1</td><td>

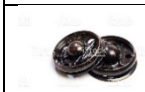
Indicative content

Credit the best complete row.

<table>
<tr><td colspan="2">Component name</td></tr>
<tr><td>1 mark</td><td>Correctly named component.</td></tr>
<tr><td>0 mark</td><td>No response or nothing worthy of credit.</td></tr>
<tr><td colspan="2">Component function</td></tr>
<tr><td>2 marks</td><td>One detailed description or two points in brief of correct component usage.

Credit even if component is incorrectly named or not given in first column. DO NOT double penalise.</td></tr>
<tr><td>1 mark</td><td>One brief correct point.</td></tr>
<tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr>
</table>

The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above.

<table>
<tr><th>Standard component</th><th>Component name</th><th>Component function</th></tr>
<tr><td>  </td><td>• Split pin
• Bifurcated rivet
• Paper fastener</td><td>• Used to fasten multiple layers of paper and card together.
• Create a hinged joint in paper or card.</td></tr>
<tr><td>  </td><td>• Press stud
• Snap fastener</td><td>• Fasten two pieces of fabric together.
• Create a closure device.</td></tr>
<tr><td>  </td><td>• Resistor</td><td>• To limit current flow in circuits.
• To limit current flow in different parts of circuits.
• To limit current flow to components damaged by excessive current.</td></tr>
<tr><td>  </td><td>Hinge</td><td>• Used to hinge a door in a door frame so it opens and closes.
• Used to provide and opening a lid on a box.</td></tr>
<tr><td>  </td><td>• Nut and bolt
• Set screw and nut</td><td>• Fasten two or more components together.
• Fasten two or more pieces of sheet material together.
• Used where a non-permanent joint or a serviceable joint is required.</td></tr>
</table>

Accept other valid responses.

</td><td>3 marks</td><td>AO4 1a
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>16</td><td>2</td><td>
<table>
<tr><td>2 marks</td><td>Two or more simple points of explanation given or one clarified in greater detail.</td></tr>
<tr><td>1 mark</td><td>A simple correct point of explanation given.</td></tr>
<tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr>
</table>
Indicative content

Look for reference to manufacturer not customer.

The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above.

• Use of similar components across a range of products meaning lots of identical components can be bought in bulk resulting in economies of scale.
• No need to design and manufacture own components as standard components can be bought in.
• Standard components are mass produced so they are low cost to the manufacturer.
• Speeds up the manufacture of products.
• Components are quality assured before they arrive at the manufacturer for them to use.
• Defective standard components can be easily replaced as part of a manufacturer guarantee if needed.
• Save on assembly time as this can be left for the customer (KD flat pack assembly). No need to use factory space for assembly.

Accept other valid responses.
</td><td>2 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>17</td><td></td><td>
<table>
<tr><td>5–6 marks</td><td>A detailed description making several correct points for selected manufacturing process using notes and/or sketches. Specific correct and appropriate process stages clearly linked to making products.</td></tr>
<tr><td>3–4 marks</td><td>A description with points showing some understanding of the selected manufacturing process using notes and/or sketches. Basic reference made to some stages of the process, but lacking links to product manufacture.</td></tr>
<tr><td>1–2 marks</td><td>Simple notes or sketch showing limited understanding of selected manufacturing process.</td></tr>
<tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr>
</table>
Indicative content

The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above.

<table>
<tr><td>Offset lithography</td><td>• A printing process used in the mass production of very long print runs.
• Prints in a combination of black, cyan, magenta and yellow inks to produce a product.
• Make use of an aluminium plate exposed to a laser image.
• Ink and water are applied to rollers from the plate roller. Water keeps the rollers wet to avoid inks sticking.
• Image from plate cylinder is transferred to rubber offset cylinder (mirror image of final print) before transferred to final material.
• Process is repeated for each of the four colours.</td></tr>
<tr><td>Turning</td><td>• A wastage process typically done using woods or metals.
• Expect responses detail use of a wood lathe or three or four jaw chucks on metal centre lathes.
• Wood is turned in a rotating chuck and the tool is stationary being moved into the path of the work piece.
• Speed of the work piece rotation is altered to reflect work piece diameter and the material being turned.
• Long pieces of work need additional support and hence are turned between centre.
• Lathes can produce bowls and spindles in wood, bore holes, turn threads and allow for drilling operations to be accommodated in all materials.</td></tr>
</table>
</td><td>6 marks</td><td>AO4 1c</td></tr>
</table>

		Casting • Heating of a material (metal, wax or a polymer/resin) then pouring it into a cavity to cool and solidify. • Complex and intricate one-piece products can be manufactured reducing assembly operations. • The mould, (allows replication), needs to be slightly bigger than required to allow for shrinkage under cooling. • Expect reference to lost wax casting, sand casting, gravity and pressure die casting. • Left over material can be recycled as can defective products manufactured which are of low quality. • Cast components can be machined, but can also be left as finished. **Injection moulding** • Allows for complex polymer shapes/products to be made rapidly in one piece, eg bottle lids. • Injection moulding uses granulated polymer granules fed from a hopper into a heating chamber to become liquid. • Molten polymer is fed under pressure via a ram or Archimedes screw into the steel mould. • Water cooling of the mould further speeds up the manufacturing process. • Left over material can be easily recycled and reused adding to further manufacturing efficiency. • Components are self-coloured and can have surface features, eg grip surfaces added in one go. **Weaving** • A shuttle loom is used to produce a plain weave. • A jacquard loom is used to produce fabrics with complicated patterns. Weaving involves two yarns being woven at 90 degrees to each other. Weft horizontally and warp vertically to loom. • Large scale manufacture completed on highly automated looms. • Set up times can be long but once done large amounts of consistent quality fabric can be produced. • Automated manufacture allows for unique fabric designs to be produced rapidly. • Use of specialist CAD software allows for simulations to be completed before a full production run reducing waste and lost time. • Main stages are shedding, picking, beating, let off and take off. **Flow soldering** • Used commercially for surface mounded components which does not involve drilling holes.		

		• Surface mount components are positioned on pre-solder pasted pads. • A PCB circuit board is first heated. • One of three ways – reflow oven, infrared lamp or hot air pencil. • Care needs to be taken controlling heat applied to avoid damage to components being joined. • Highly suited to mass production of circuit boards as minimal human involvement. Accept other valid responses.		

Qu	Part	Marking Guidance	Total marks	AO
18		Methods ensuring quality control. A maximum of three marks for one of the given methods only. 3 marks – Two or more points considered in detail or three points considered in brief. 2 marks – Two simple points of explanation given or one clarified in greater detail. 1 mark – A simple correct point of explanation given. 0 marks – No response or nothing worthy of credit. **Indicative content** The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above. **Dimensional accuracy** • Important to ensure products are manufactured within tolerance, eg length, width, thickness, diameter, resistor tolerance. • Use of jigs, templates and stencils to ensure consistent sizing is used. • Adoption of CAD and CAM to work to a very fine tolerance better than a human. • Promote precision, reduce product/component defects. **Process time** • Developing times in PCB manufacture. Avoid over exposure of a PCB board to UV light. • PCB etching limit time in a PCB etch tank to ensure copper tacks are not removed/become porous. • Correct drying and curing times adhered to before loading/product use. **Registration accuracy** • Check the quality of printing in an image. • A circle with a cross through it is used to check if all inks printed are correctly aligned. • Make sure image is not blurred – circle and cross lines will appear blurred. Accept other valid responses.	3 marks	AO4 1b

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>19</td><td></td><td>
<table>
<tr><td>7–8 marks</td><td>A fully detailed analysis and evaluation of a majority of the 6Rs. An excellent consideration of how the 6Rs help consumers make an informed decision.</td></tr>
<tr><td>5–6 marks</td><td>A good analysis of several of the 6Rs with some evaluative points. Good consideration of how the 6Rs help consumers make an informed decision.</td></tr>
<tr><td>3–4 marks</td><td>Basic analysis of some of the 6Rs. Limited generic evaluation of use by a consumer.</td></tr>
<tr><td>1–2 marks</td><td>One or two simple points showing some understanding of the 6Rs.</td></tr>
<tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr>
</table>
Indicative content

The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above.

Analysis

Identification as to meaning of the 6Rs.

Evaluation

Judgment on impact of the 6Rs on helping the consumer.

Expect references to decisions and choices customers may have to make.

Expect specific products examples to be used to extend responses.

Reduce:
• saving materials and/or energy in production
• efficient manufacturing
• use of sustainable materials, eg consumer may look for FSC mark on a timber product
• reducing product parts or variety of materials used.

Refuse:
• the customer needs to reflect and decide if they really need the product, eg latest phone, or will an upgrade do
• use of chemical products harmful to the environment, eg biological detergents
• reject the use of unsustainable materials or products that are unethical, eg high CO2 emission vehicles.

Reuse:
</td><td>8 marks</td><td>AO3 2a
AO3 2b</td></tr>
</table>

		• can a product be reused or repurposed, eg bags for life, rechargeable batteries, refillable bottles and containers • visiting charity shops to purchase clothing which may have had little use or have been an unwanted gift • upcycling of furniture, ie 'shabby chic'. **Repair**: • rather than disposing of a worn or broken product, can it be repaired • purchasing a reconditioned vacuum cleaner creates a satellite industry and job opportunities for people in society possible working from home • also meets a need of a consumer if they do not have the disposable income to buy new all the time • buying simple products that are repairable to ensure they will have an extended life and not require new materials and resources to be consumed. **Recycle**: • manufacturers should be clear how products can be recycled (labels, stickers, instructions) at the end of their useful life if they cannot be reused etc • by EU law electronic manufacturers have to abide by the WEEE directive of 2006 • are materials used that can be recycled, eg Marks and Spencer removed glitter from all Christmas cards in 2019 as they were virtually impossible to recycle in this condition • purchase products made from limited materials and not requiring extensive and complex separation. **Rethink**: • consider how a product can be made in a more sustainable way and promote this/highlight this to customers, eg two hour charge time of the Tesla and 200 miles plus range • rethink the ways we travel and commute • are materials sourced locally • sustainable production • is the product sustainable itself, eg does it use solar power. Accept 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>20</td><td>1</td><td>
Method 1
<table>
<tr><td>1 mark</td><td>Conversion from mm to cm:

600 = 60, 450 = 45 and 200 = 20

Note: One correct conversion can be given the mark.</td></tr>
<tr><td>1 mark</td><td>Find volume using L × W × H:

60 × 45 × 20 = 54 000 cm^3</td></tr>
</table>
Method 2
<table>
<tr><td>1 mark</td><td>Find volume using L × W × H:

60 × 45 × 20 = 54 000 000</td></tr>
<tr><td>1 mark</td><td>Conversion of volume from mm^3 to cm^3

54 000 000 ÷ 1000 = 54 000 cm^3</td></tr>
</table>
</td><td>2 marks</td><td>AO4 2c</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>20</td><td>2</td><td>
<table>
<tr><td>1 mark</td><td>Step 1: volume × mass

their 54 000 × 1.6 = 86 400</td></tr>
<tr><td>1 mark</td><td>Step 2: in kgs

their 86 400 ÷ 1000 = 86.4</td></tr>
<tr><td>1 mark</td><td>Step 3: to nearest whole kg

their 86.4 correctly rounded to the nearest kg = 86</td></tr>
</table>
Note: Where candidate has used values different to 54 000 cm^3 or 1.6 g/cm^3 in question 20.1 but the method is correct ALL marks for this question are available.

DO NOT double penalise.
</td><td>3 marks</td><td>AO4 2c</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>1</td><td>
<table>
<tr><td>3–4 marks</td><td>A detailed analysis and evaluation of how aesthetics are considered. Wholly appropriate links to vacuum cleaner design are given.</td></tr>
<tr><td>1–2 marks</td><td>Limited analysis and evaluation of how aesthetics are considered in vacuum cleaner design.</td></tr>
<tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr>
</table>
Indicative content

• Modern manufacturers try to give their design a ‘wow factor’ so it will appeal to customers more and they will buy one brand over another.
• Use of bright and bold colour schemes to attract potential customers and ‘draw the customer in’.
• Use of quality materials and construction processes to improve the looks of the vacuum cleaner over time, eg self-coloured/finished polymers for body parts which can be wiped down and scuff marks removed.
• Aesthetics can be damaged with poor quality materials or finish of materials making a product look of low quality and something discerning customers won’t want in their homes.
• Battery powered vacuum cleaners. Lithium ion batteries have removed the need for any trailing cables when in use, improving appearance.
• Compact nature of cordless/battery cleaners means they can be stored discretely improving product aesthetics when stored as well as that of the room.
• Futuristic and ‘high tech’ looking designs, eg robotic cleaners moving around a room unaided.

Accept other valid responses.
</td><td>4 marks</td><td>AO3 1a
AO3 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>2</td><td>
<table>
<tr><td>3–4 marks</td><td>A detailed analysis and evaluation with reference to needs and wants of vacuum cleaner users. Expect more than simple generic statements.</td></tr>
<tr><td>1–2 marks</td><td>Simplistic statement(s) of user needs or wants.</td></tr>
<tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr>
</table>
Indicative content

The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above.

Examples of banded responses:

Four mark response
The vacuum cleaner needs to allow the user to keep their home clean as efficiently as possible. They want a vacuum cleaner that requires as little effort as possible to use as the user could be an older person. It needs to manoeuvre into tight and awkward spaces to ensure no dirt is missed. The user will want to know when the vacuum cleaner is full and needs emptying and be able to do this without creating any extra mess.

Three mark response
The vacuum cleaner needs to be easy to use by the user and this could be people of several different ages and size. The user will be looking for a stylish product so users will want to buy it and make the manufacturer money.

Two mark response
The vacuum cleaner needs to suck up dirt and be easy to manoeuvre around by the user. (An example of two simple points.)

The vacuum cleaner needs to be able to suck up dirt to keep the user’s home clean and tidy. (A qualified response.)

One mark response
The vacuum cleaner needs to suck up dirt for the user.

Note: Give a maximum of two marks for a list of unexplained bullet point features not explained or linked to user, eg:
• keep house clean
• suck up dirt
• easy to store when not in use.

Accept other valid responses.
</td><td>4 marks</td><td>AO3 1a
AO3 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>3</td><td>
<table>
<tr><td>3–4 marks</td><td>Clear analysis and evaluation as to how iterative design could be used to improve the vacuum cleaners.</td></tr>
<tr><td>1–2 marks</td><td>Brief/simplistic statement(s) about iterative design. Limited evaluation as to how it is used to improve vacuum cleaners.</td></tr>
<tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr>
</table>
Indicative content

Iterative design is:
• about prototyping, testing then evaluating a product
• each iterative cycle leads to small incremental refinements in the product (feedback)
• evaluating by seeking to find out the views and opinions or clients and potential customers or end users
• about taking small steps with a design and responding to feedback.

It improves vacuum cleaners as:
• each iteration is designed to improve both the quality and the function of the product, eg removal of dust collection chamber
• iterative design should work out and remove problems and quality issues before it reaches commercial production, eg speed of cable retraction
• iterative design can limit unnecessary expense in having to stop production of a commercial product/withdraw it as potential issues and flaws should have been removed during development and prototyping.

Accept other valid responses.
</td><td>4 marks</td><td>AO3 1a
AO3 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>22</td><td>1</td><td>
Method 1
<table>
<tr><td>1 mark</td><td>1.5 × 2 = 3 cm or 15 × 2 = 30 mm</td></tr>
<tr><td>1 mark</td><td>30 - 3 = 27 cm or 300 - 30 = 270 mm</td></tr>
<tr><td>1 mark</td><td>Internal panel area is
27 × 27 = 729 cm^2 or 270 × 270 = 72900 mm^2</td></tr>
<tr><td>1 mark
(science)</td><td>Answer in centimetres or Answer in millimetres</td></tr>
</table>
Method 2
<table>
<tr><td>1 mark</td><td>2 long strips
30 × 1.5 × 2 = 90 cm^2 or

300 × 15 × 2 = 9000 mm^2</td></tr>
<tr><td>1 mark</td><td>And 2 short strips
27 × 1.5 × 2 = 81 cm^2 or

270 × 15 × 2 = 8100 mm^2</td></tr>
<tr><td>1 mark</td><td>Area lost where sides touch base is
900 - 90 - 81 = 729 cm^2 or

90 000 - 9000 - 8100 = 72 900 mm^2</td></tr>
<tr><td>1 mark
(science)</td><td>Answer in centimetres or Answer in millimetres</td></tr>
</table>
Method 3
<table>
<tr><td>1 mark</td><td>4 × 28.5 × 1.5 = 171 cm^2 or

4 × 285 × 15 = 17 100 mm^2</td></tr>
<tr><td>1 mark</td><td>30 × 30 = 900 cm^2 or

300 × 300 = 90 000 mm^2</td></tr>
<tr><td>1 mark</td><td>900 - 171 = 729 cm^2 or

90 000 - 17 100 = 72 900 mm^2</td></tr>
<tr><td>1 mark
(science)</td><td>Answer in centimetres or Answer in millimetres</td></tr>
</table>
Accept any other appropriate methods.
</td><td>4 marks</td><td>AO4 2b
AO4 2c</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>22</td><td>2</td><td>
<table>
<tr><td>1 mark</td><td>Recognition that ratio is how many times height of original elevation divides into enlarged elevation:

$\frac{300}{75} = 4$</td></tr>
<tr><td>1 mark</td><td>Ratio is:
4:1</td></tr>
</table>
If candidate gives answer of 4:1 with no working award full marks.

N.B. Award 1 mark (half marks) if candidate gives 1:4
</td><td>2 marks</td><td>AO4 2b
AO4 2c</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>23</td><td>1</td><td>
<table>
<tr><td>1 mark</td><td>One correct product.</td></tr>
<tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr>
</table>
Indicative content

The guidance provided is illustrative and not exhaustive.

Fairtrade products include:
• bananas
• beauty products
• cleaning products
• cocoa
• coffee
• cotton
• dried fruit
• gold products
• homeware
• honey
• juices
• nuts and oil seeds
• oranges
• quinoa
• rice
• spices
• sports balls
• sugar
• tea
• vegetables
• wine.

Accept other valid responses.
</td><td>1 mark</td><td>AO4 2a</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>23</td><td>2</td><td>
<table>
<tr><td>4 marks</td><td>Full response – two or more points considered in detail or three points considered in brief and one example of people who benefit from Fairtrade.</td></tr>
<tr><td>3 marks</td><td>One or more points considered in detail or two points considered in brief and one example of people who benefit from Fairtrade.</td></tr>
<tr><td>2 marks</td><td>Two simple points of explanation given or one simple point and one example of people who benefit from Fairtrade.</td></tr>
<tr><td>1 mark</td><td>One simple explanation point as to the need for Fair trade or one example of people who benefit from Fairtrade.</td></tr>
<tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr>
</table>
Indicative content

The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above.

Function of the Fairtrade organisation and what work does it do:
• ensures that workers in developing/third world countries get a fair price for their work/products
• better price for products at source/origin
• improving pay for workers in developing countries
• improving working conditions for workers and their families in developing countries
• supporting workers with poorer health and safety legislation than workers in first world developed countries
• improving education and access to social care in developing countries
• empowering workers in the developing world to have power and influence over their lives
• gives small scale farmers access to global markets
• Supports sustainability.

Credit specific examples, eg
• Fairtrade Cotton – Cotton farmers are paid a living wage which allows them to survive and earn enough money to feed their families.
• Communities are often given help in setting up local amenities such as schools, wells etc.

Accept other valid responses.
</td><td>4 marks</td><td>AO4 2b</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>24</td><td></td><td>
Maximum of three marks each for focus groups and market research responses.

NB Maximum of two marks if no example is provided in response.

<table>
<tr><td>3 marks</td><td>A very detailed and well explained example provided to clarify understanding of the techniques.</td></tr>
<tr><td>2 marks</td><td>A simply described understanding of the technique using an example or a well described understanding with no example.</td></tr>
<tr><td>1 mark</td><td>Simple statement demonstrating understanding of technique with no example.</td></tr>
<tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr>
</table>

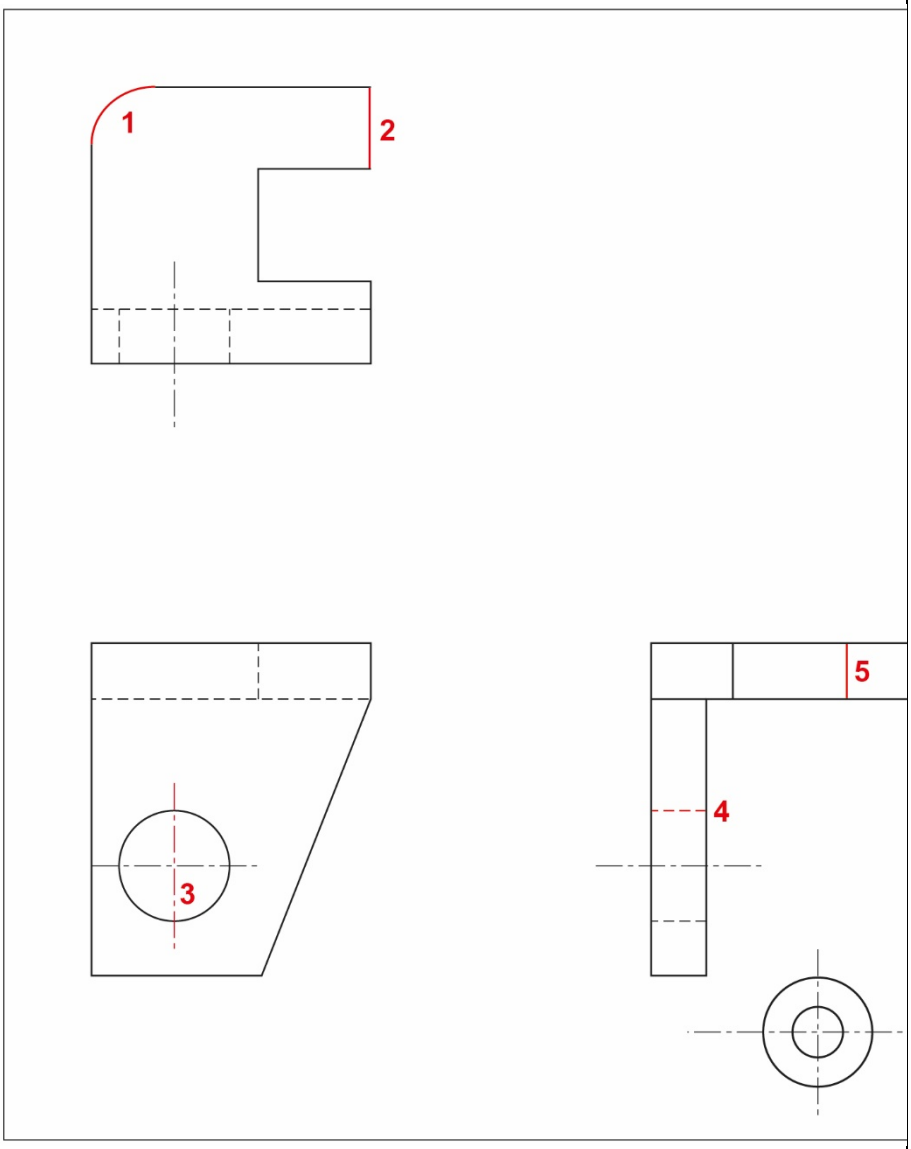
Indicative content

The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above.

Focus groups
• A primary source of information gathering, eg unlike written articles or online resources completed by another.
• Very specific way of finding useful research talking to people of interested parties to prepare/help with designing, eg about a prototype product.
• A gathered group of people where opinions and perceptions are observed/discussed/shared, eg features of a recently released product like a child’s toy.
• Focus groups allow for people to interact and share views and opinions unlike say interviews/survey/poll usually completed by/with an individual.
• Allow a designer or manufacturer to talk/engage directly with consumers/customers.

Market research
• A consideration of what’s already on the market (product analysis), eg a competitor may want to evaluate the good and bad points (customer perceptions) of a mobile phone or 100% electric car against hybrid.
• A critical evaluation of what’s already on the market and what they would be in competition with.
• Identification of a gap in the market for a particular product.
• A manufacturer will want to know if the development of a product is viable, eg like Land Rover with the first SUV in the 1970s or more recently Nespresso with their coffee pod machines.
• May involve interviews or surveys.

Accept other valid responses.
</td><td>2 x 3 marks</td><td>AO4 2b</td></tr>
</table>

Qu	Part	Marking Guidance	Total marks	AO
25		One mark for **each** correctly added feature.  **Indicative content** 1 = radius 2 = solid vertical line 3 = vertical centre line 4 = hidden detail line 5 = vertical solid line	5 marks	AO4 2c

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>26</td><td></td><td>
<table>
<tr><td>5–6 marks</td><td>A detailed description making several correct points for selected process using notes and/or sketches. Specific correct and appropriate process stages and specific equipment given.</td></tr>
<tr><td>3–4 marks</td><td>A description with points showing some understanding of the selected process using notes and/or sketches. Basic reference made to some stages of the process with some equipment given.</td></tr>
<tr><td>1–2 marks</td><td>Simple notes or sketch showing limited understanding of selected process and/or equipment.</td></tr>
<tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr>
</table>
Indicative content

The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above.

<table>
<tr><th>Material group</th><th>How prepared for treatment or application of finish and equipment</th></tr>
<tr><td>Papers and boards</td><td>1. Select ream and correct paper weight for product.
2. Check paper is board is un-creased/free from surface defects.
3. Check alignment for finishing process to commence, eg feed into offset litho printer.

Typical finishes that may be used in responses are:
• Printing, eg offset litho printing
  • ink and water are applied by rollers to plate cylinder
  • rollers are kept wet so ink does not stick
  • mirror image product for transfer to product.
• Spot varnishing
  • application of a varnish via stencil
  • varnish cured using UV light.
• Embossing
  • creation of a male, (counter die), and female, (relief), die
  • paper is aligned
  • pressure and sometimes heat is then applied.
• Lamination
  • insertion of a piece of paper in a polymer laminate
  • hot lamination (as in schools) requires correct temperature to be used
  • correct feed in of laminate and paper through motorised rollers.</td></tr>
</table>
</td><td>6 marks</td><td>AO4 2b</td></tr>
</table>

		Timbers	Most wood finishes involve the use of many of the following stages: 1. Check timber is free from defects, eg splits, warping, knots etc. 2. Ensure surface is sanded down with increasingly fine abrasive paper, (bigger numbers are finer grades). 3. Apply finish in a dry dust free environment. 4. Application of a primer, eg knotting compound may be needed. 5. Application of an under coat (to accept a top coat). 6. Allow to dry and lightly rub down between each applied layer. 7. Application of one or more top coats. Typical finishes that may be considered are: • painting • varnishing • oiling • waxing • staining.		
		Metals	Many metal finishes involve the use of volatile organic compounds, (VOCs), and hence need to be: 1. carried out in well ventilated rooms and using appropriate Personal Protection Equipment (PPE) 2. make sure metal is free from dust, dirt and grease. Sometimes (certainly commercially) a pickling bath is used to ensure this. Typical finishes that may be considered in responses are: • Plastic dip coating A school-based finishing process involving the use of a heat source to warm the metal (usually a brazing torch) and a fluidising bed or dip coating tank with polymer powder in is to which air is blown through. • Powder coating A commercial spray applied finish where large metal object eg table underframes are mounted on a conveyor belt, moving slowly through a heated autoclave until a sprayed polymer finish is applied, (electrostatic finish). • Metal primer and paint Similar to prep stages for wood, ie primer, undercoat, top coat. • Galvanizing • usually hot dipped to steel after a thorough degreasing		

			• steel object is immersed in a tank of molten zinc.
			• Electroplating and anodising
			  • metal needs to be free from dust, dirt and grease
			  • metal object is then immersed in an electroplating tank attached to one electrode, with another metal, eg silver, attached to another electrode
			  • a current is passed through tank leading to the deposition of silver onto a base material
			  • a primer layer of electrically deposited copper is applied to brass musical instruments as silver does not stick to brass.		

		Polymers	Most plastics are self-finished in a school context so expect reference to
			• Laser cutting
			correct settings, ie power, speed and pulses (PPI) for laser cutting.
			• Vacuum forming
			some responses may discus use of MDF as suitable for vacuum forming moulds as it does not have a grain.
			
			Typical surface finishes that may be considered in responses are:
			• application of vinyl graphics/decals
			  • reference to degreasing of material surface with solvent
			  • use of application or frisk film to apply the decals.		

		Textiles	Many commercial textile finishes involve the use of volatile organic compounds (VOCs) and hence need to be carried out in well ventilated rooms and using appropriate Personal Protection Equipment (PPE). Textiles finishing in schools may consider: • batik • screen or block printing • dye sublimation printing • iron on printing. Preparation before dyeing and finishing are mainly: 1. washing to remove ‘size’, (paste which adds stiffness during manufacture) 2. scouring to remove grease 3. washing/steaming to pre-shrink or de-crease 4. stretching on a tenter or stenter to keep fabric taut.		

		Typical surface finishes that may be considered in responses are: • flame retardancy • stain protection • crease resistance • heat transfer printing • distressing, eg stone washing • calendering – passing through rollers to smooth material or emboss designs • brushing, eg brushed cotton (sheets) to improve softness. Accept other valid responses.		

Qu	Part	Marking Guidance	Total marks	AO
27	1	One mark for correctly named technique. **Indicative content** Accept: • annotated drawing • annotated sketch/sketches • notes and sketches. Do **not** accept: • drawing/sketches • isometric drawing • oblique drawing • freehand drawing • 3D drawing • perspective drawing • cut away • rendering.	1 mark	AO4 2a

Qu	Part	Marking Guidance	Total marks	AO
27	2	4 marks: Excellent response that considers a range of relevant aspects, eg materials, finishes, construction or function, especially the main advantage of additional clarification obtained by adding notes. Allows discussion with self and others. 3 marks: A good response that considers most aspects but omits some important issues. 2 marks: The response considers a single aspect in depth, but fails to mention the wider applications of annotation. 1 mark: A limited response that briefly describes the function of notes but not why they are a useful feature. 0 marks: No response or nothing worthy of credit. **Indicative content** They convey an understanding to the third party of information that a sketch or drawing alone is unable to do. Expect references to: **Materials**, eg sketches alone will not provide material detail. Annotated sketches allow the designer to share thought on material choices, relative advantages and disadvantages of different	4 marks	AO4 2b

		materials and choices. Additional detail may include things like material costs, availability and stock forms and sizes **Constructions**, eg the designer can share with the third party detail on possible construction, fabrication and assembly techniques for both a prototype, scaled model and/or commercial product. **Finishes**, eg detail on appropriate finishes to be applied (or not). **The customer**, eg comment and feedback relating to analysis and evaluation of a customer's needs and wants can be added to clarify future design intentions. **The specification**, eg the designer can revisit and consider specification points and review how well the prototype or product being designed satisfies design requirements. Accept other valid responses.		