SPECIMEN MATERIAL

GCE A LEVEL
PRODUCT DESIGN
7552/2

PAPER 2

Mark scheme

Specimen

Version number 1.0

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 Assessment Writer.

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.

Qu	Part	Marking guidance	Total marks	AO
01		Marks: 7-8 — The candidate shows a thorough understanding of **specific** relevant material properties referring to the juicer. The two materials are compared and their suitability for the product is evaluated with reference to function, manufacturing and aesthetic considerations. 5-6 — The candidate shows an understanding of some relevant material properties referring to the juicer. The two materials are compared and their suitability for the product is evaluated with some reference to function, manufacturing and aesthetic considerations. 3-4 — The candidate shows understanding of relevant material properties which are stated but not fully evaluated in relation to their suitability for the product. 1-2 — Few generic properties are stated. Little evidence of any evaluation being carried out. 0 — Nothing worthy of credit. **Indicative Content:** • The aluminium juicer in figure 1 will not degrade by 'rusting' due to it being a non-ferrous material. • The polypropylene juicer in figure 2 is extremely chemically resistant and will not be affected by cleaning products. • The aluminium juicer is suitable for large scale batch production through high pressure die-casting. The polypropylene juicer can be mass produced through injection moulding. • The polypropylene juicer would be available in a wide range of colours, which can be simply achieved using pigments in the injection moulding process. Although the aluminium juicer can be anodised to change the colour or have a finish applied this would not be full thickness and may scratch. • Polypropylene is a thermal insulator making it ideal for washing in hot water/dishwashers, aluminium will conduct heat and may be too hot to handle when the dishwasher initially finishes, meaning hand washing would be better. • Aluminium has a relatively low melting point for a metal making it	**8 marks** (4 marks AO31A, 4 marks AO31B)	AO3

		ideal for casting • Aluminium is can be machined easily after casting to remove defects. • Polypropylene is resistant to work fatigue meaning that it will flex when pressure is applied rather than crack. • Polypropylene can be formed in thin sections suitable for clip fittings used to join the juicer together. • Accept any other valid response		

2		**Mark Scheme:** **5-6 marks** – The response clearly understands relevant QA and QC checks for the process **3-4 marks** – The response refers to QC or QA checks being implemented with some explanation of the checks/procedures use. **1-2 marks** – The response refers to QC or QA checks being implemented, but is not specific about the checks undertaken **0 marks** – No answer worthy of credit **Indicative Content:** • Visual Quality Control checks used on random samples of products • Mould markings checked and specific moulds isolated and adjusted • Regular mould maintenance schedule to ensure no defects • Mould temperature monitored and adjusted using cooling etc. • Cycle time monitored and adjusted appropriately • Use of Six Sigma to assess acceptable level of errors (3.4 units per million) • Use of mould flow analysis prior to mould design to check polymer flow when injection moulding • Accept any other valid response	**6 marks** AO42C	

<table>
<tr><td rowspan="8">3</td><td rowspan="8"></td><td>Marks</td><td>Description</td><td rowspan="8">4 marks
AO42B</td><td rowspan="8">AO4</td></tr>
<tr><td>4</td><td>An appropriate product example is used and the response makes reference to specific features of the product to show how it conforms to the principles of ‘form follows function’ and a specific design movement.</td></tr>
<tr><td>3</td><td>An appropriate product example is used and the response makes reference to features of the product to show how it conforms to the principles of ‘form follows function’.</td></tr>
<tr><td>2</td><td>An appropriate product example is given and ‘form follows function’ is referenced, but without linking to specific features of the product example.</td></tr>
<tr><td>1</td><td>An appropriate product example is used without reference to design theory of ‘form follows function’.</td></tr>
<tr><td>0</td><td>Nothing worthy of credit.</td></tr>
<tr><td colspan="2">Indicative Content:

Examples of appropriate products that could be referenced by a student:
Bauhaus chairs, Electric toothbrush

• It is expected that responses may refer to the appearance or aesthetics of a product being dictated by its ability to fulfil its purpose.
• Better responses will refer to a lack of ornamentation and a minimalist approach to design.
• Reference may be made to the Bauhaus design school and possibly other functionalist designers such as Dieter Rams.
• Accept any other valid response</td></tr>
</table>

<table>
<tr>
<td>4</td>
<td></td>
<td>Mark Scheme:

<table>
<tr><td>7-9</td><td>The response demonstrates excellent knowledge and understanding of a range of relevant technological developments, which are discussed with reference to the evolution of the products.</td></tr>
<tr><td>4-6</td><td>The response demonstrates good knowledge and understanding of a range of relevant technological developments, which are discussed with some reference to the evolution of the products.</td></tr>
<tr><td>1-3</td><td>The response recognizes the main technological developments with little explanation of relevance to the products.</td></tr>
<tr><td>0</td><td>Nothing worthy of credit</td></tr>
</table>

Indicative Content:
• The development of thermoplastics including ABS and Polycarbonate has allowed the forming of complex 3D forms in a wide range of colours not available through sand casting (used or the original vacuum cleaner base.
• The use of thermoplastics has decreased the weight of the vacuum cleaner.
• The development of CAD modeling has allowed 3D complex formed to be modeled and tested prior to production, improving efficiency of operation through mathematical testing.
• The development of CNC processing allowed for complex mirror finished moulds to be produced through EDM machining instead of casting from a hand made prototype.
• The development of the injection moulding process allowed the production of interlocking polymer components in single parts instead of through fabrication.
• The development of Li-ion batteries has enabled high suction power to be maintained in a cordless vacuum cleaner.
• The development of cyclone technology has greatly increased the efficiency of the vacuum and removed the need to have a bag
• Accept any other valid response</td>
<td>9 marks
AO42B</td>
<td></td>
</tr>
</table>

5			**3 marks AO42B**	

3 marks	An appropriate product example is named with a detailed explanation of the concept
2 marks	An appropriate product example is named with a simple explanation of the concept
1 mark	An appropriate product example is named without an accompanying explanation of the concept

Indicative content:

'Good design is understandable'
Students may make reference to points such as:

- Well-designed products are easy to use
- 'Understandable' means that the design is intuitive and reduces the cognitive load of the user
- The function of a well-designed product is self-evident
- A good design does not require instructions
- There is a focus on user experience
- The product communicates its purpose intuitively

The product examples will be varied, but the justification may refer to use of standardised colours, symbols forms etc. to break language barriers and make the product inclusive.

Relevant product examples may include:

- TV remote control
- Pelican crossing
- Electric toothbrush
- Car heater controls

- Accept any other valid response

6		**Quality Assurance**: 1 mark – Answer makes reference to procedures/policies to ensure 'right first time' or reduction of waste 2 marks – Answer additionally makes reference to production within acceptable tolerances The procedures and policies put in place to reduce waste and ensure manufactured products are produced accurately within set acceptable tolerances. Students may give some examples to exemplify point but these are not required for full marks. - Accurate dimensioned engineering drawings being used for checking dimensional accuracy. - Setting temperature tolerances for materials during forming processes. - Setting regularity of mould/cutter changes to avoid excessive wear. **Quality Control:** 1 marks – Answer makes reference to monitoring, checking or testing products during production 2 marks – Answer also makes reference to conforming to tolerances set in QA The monitoring, checking and testing of materials components, equipment and products throughout production to ensure they conform to acceptable tolerances. Students may give some examples to exemplify point but these are not required for full marks - Visual checks to check for obvious aesthetic defects - Stress testing to check for internal defects. - Destructive interval testing on a production line.	**4** marks	AO42A

7		One mark for correct percentage identification. Use of more than one tick/lozenge = 0 marks for the question Answer: 1/25 = 4% tolerance	**1** mark	AO42C

8		Marks	Description	**12** marks	AO31A: 6 marks AO31B: 6 marks
		10-12	The response demonstrates an excellent understanding of social, moral and ethical impact of mobile technology on society over the last 30 years. The response provides balanced analysis and evaluation of both positive and negative aspects of technology, composing a clear discussion, which reaches a reasoned conclusion based on the evidence provided.		
		7-9	The response demonstrates a very good understanding of the social, moral and ethical impact of mobile technology on society over the last 30 years. The response shows analyses the impact of both positive and negative aspects of the technology and evaluates the impact of these, drawing a relevant conclusion.		
		4-6	The response demonstrates a good understanding of the social, moral and ethical impact of mobile technology on society over the last 30 years. The response deals largely with only either the positive or negative aspects of the technology, which are outlined with some evaluation.		
		1-3	The response demonstrates some understanding of the social, moral and ethical impact of mobile technology on society over the last 30 years. The response analyses only either the positive or negative aspects of technology in short statements with very little evaluation.		
		0	Nothing worthy of credit		
		The content below must be expanded upon with analysis of the impact on society to warrant marks for evaluation. **Indicative content:** • Improved communication due to mobile signals such as wifi,			

		Bluetooth, 3G and 4G. • Mobile phones have improved safety for individuals walking home and in isolated locations – consider to what extent is there a "trade-off" in terms of increased level of safety against the potential negative aspects of mobile technology referred to elsewhere • The increased online access and private nature of 'surfing' on a smartphone means parents are less aware of children's internet access. Contrast this with the advantages gained through having immediate access to information to enable them to take decisions. • Increased risk of cyber bullying and other cyber-crime, e.g. financial risks • Reduced literacy skills due to text speak • The extent to which individuals are not more aware of issues across the world given the increased accessibility to information that previously would only have been available through particular media (tv, newspapers, etc.) • The constant reliance on tablets and phones affects social interactions and also reduces exercise. • By combining a range of devices into a single 'smartphone', reduces power usage. To what extent has this impacted upon the sale and use of other technology, e.g. cameras, GPS systems, etc. • Peer pressure placed upon young people to have the latest technology and how this impacts upon friendship groups, relationships with parents, bullying, etc. • The increased use of laptops may damage male fertility. • The introduction of satellite navigation systems and other mobile technology, may effect our memory in later life, as we no longer have to remember routes to places, or peoples telephone numbers etc. • The use of mobile technology means we are nearly always connected and very rarely switch off. This can mean increased stress and depression • The introduction of 'smart watches' has allows even greater connectivity and monitoring of activity allowing us to record exercise and plot progress. • Accept any other valid response		

<table>
<tr><td rowspan="6">9</td><td rowspan="6"></td><td>Marks</td><td>Description</td><td rowspan="6">10 marks</td><td rowspan="6">5 marks AO31A: 5 marks AO31B</td></tr>
<tr><td>8-10</td><td>The candidate shows excellent understanding of the impact of specific legislation which is related directly to product design. The response analyses the impact of the legislation in detail and evaluates its impact upon product design with reference to relevant examples of developments/modifications to products.</td></tr>
<tr><td>5-7</td><td>The candidate shows a good understanding of the impact of specific legislation which is related directly to product design. The response evaluates the impact of the legislation, making reference to relevant product examples.</td></tr>
<tr><td>1-4</td><td>The candidate refers to legislation but shows a basic understanding of the relationship to product design. There is little evaluation of any impact upon product design and the response may be descriptive, rather than evaluative.</td></tr>
<tr><td>0</td><td>Nothing worthy of credit</td></tr>
<tr><td colspan="2">Indicative content

• Possible legislation:
- RoHS: Reduction of Hazardous Substances removal of: lead, cadmium mercury as applicable to a wide range of products. This has meant changes to the design of electrical equipment to adapt to using new materials to ensure compliance.
- Battery Directive: As batteries are not covered by RoHS compliance the battery directive is seen as a separate legislation covering cadmium and mercury etc. This fixes targets for collection and recycling of batteries and sets out provisions on the labelling of batteries and their removability from equipment.
- WEEE Directive: The directive covering the target to recycle waste electronics. The most recent aim was for more than 85% by 2016.
- Accept references to packaging directives.

Impacts on design:
- Selection and use of raw materials, design that takes account of the life cycle of a product
- Design to ensure energy efficiency to comply with eco-design requirements</td></tr>
</table>

		- Design for recycling of materials - Design for reuse - Waste from product manufacture - Designing to ensure that products are safe to use and meet the requirements of safety legislation Potential product examples: • Energy efficient lightbulbs • Large/Small household appliances • IT and telecommunications equipment • Electrical and electronic tools • Accept any other valid response		

10		Mark	Description	**3** marks AO42A	
		3	More detailed response referring to an additional aspect such as the process of transforming by-products, waste materials, useless and/or unwanted products into new materials or products of better quality or for better environmental value. May refer to it as creative reuse.		
		2	Response states that upcycling is the process of transforming unwanted products into a new material or product		
		1	Basic response which simply refers to upcycling as the reuse/repurposing of a product.		
		0	Nothing worthy of credit.		

11		Mark	Description	3 marks AO42A	
		3 marks	Answer states that an eco-label is the labelling of a product with a distinctive label to prove it conforms to recognised environmental standards, and including a specific example label.		
		2 marks	Answer states that an eco-label is the labelling of a product with a distinctive label to prove it conforms to recognised environmental standards.		
		1 mark	Answer states a recognised eco label with no explanation **or** explaining that eco-labelling is the practice of labelling a product with a distinctive label.		

		0 marks | Nothing worthy of credit Indicative content: Examples of eco-labels: • The Mobius loop • European eco-label • NAPM recycled mark • The EC energy label • The Energy Efficient label and logo • Forest Stewardship Council (FSA) • EPA Energy Star • Accept any other valid response		

12		3-4 marks | Response demonstrates excellent application of knowledge and understanding of the environmental impact of food packaging and includes 3-4 relevant points 1-2 marks | Response demonstrates good knowledge and understanding of the environmental impact of food packaging and includes 1-2 relevant points 0 | Nothing worthy of credit Indicative content: • Reducing size of food packaging • Standardised shapes for efficient transportation • Smart packaging to preserve food for longer • Use of easily recyclable materials such as cardboard • Reducing number of materials used and standardising polymers to aid recycling • Use of biodegradable polymers eg corn starch polymers • Reduction in use of oil based plastics • Accept any other valid response	**4 marks** AO42C	

13		Compare the use of two materials for packaging large electronic products **3-4 marks** – The response demonstrates good understanding of material properties and compares the two types of packaging in detail with reference to 3-4 aspects such as: properties and characteristics of the material used, suitability for the given application and implications of each material for disposal of the packaging. **1-2 marks** – The response demonstrates understanding of material properties and compares the two types of packaging in detail with reference to 1-2 aspects such as: properties and characteristics of the material used, suitability for the given application and implications of each material for disposal of the packaging. **0 marks** – Nothing worthy of credit • The expanded polystyrene package can be moulded to match the product and the outer box exactly giving good shock absorption properties. • The paper pulp container is formed to the product shape, but leaves an air gap between the product and the outer box increasing shock absorption and reducing volume of material • The EPS package is non-recyclable and breaks down when removed from the main package, causing environmental issues. • The paper pulp will not break into small pellets and is easily recycled • The EPS is being replaced with a starch based option • Accept any other valid response	4 marks AO42B	

14		Answer requires candidate to use a volume scale factor to calculate the answer Calculate existing volume of games console: 100x200x300 = 6 000 000 mm^3 — 1 b. Calculate 75% volume: 6 000 000 x .75 = 4 500 000 mm^3 Recognition of volume scale factor as 0.75 Application of $\sqrt[3]{}$ 0.75 to get the length scale factor: = 0.90856…. — 1 Use of $\sqrt[3]{}$0.75 to convert each length	5 marks AO42C	

		A = $\sqrt[3]{0.75}$ X 100 = 90.86 mm — 1 B = $\sqrt[3]{0.75}$ X 200 = 181.71 mm — 1 C = $\sqrt[3]{0.75}$ X 300 = 272.57 mm — 1		

15	The response shows a calculation to work out an arc length or the two arcs length combined $2\pi \times \frac{150}{4}$ or [235.5, 236] or $2\pi \times \frac{150}{2}$ or [471, 472]	1 mark	4 marks AO42C
	The response shows calculations to work out the total length of the inner layer touching the foam former. $2\pi \times \frac{150}{4} \times 2 + 300$ or [235.5, 236] × 2 + 300 or $2\pi \times \frac{150}{2} + 300$ or [471, 472] + 300	2 marks	
	The response shows calculations as above and some compensation for the increased radii but may use the wrong number of layers.	3 marks	
	The response shows **full** calculations to compensate for the increased radii due to seven layers of plywood R = 150 + (7 × 1.5) = 160.5 2π x 160.5/2 +300 = (504.23 + 300) $2\pi \times \frac{160.5}{2} + 300$ or [503.97, 504.3] + 300 or [803.97, 804.3] Outside length = 804mm (nearest millimetre)	4 marks	