SPECIMEN MATERIAL

A Level
DESIGN AND TECHNOLOGY (PRODUCT DESIGN)
7552/1

PAPER 1

Mark scheme

Specimen Papers

V.1.1

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		1 mark for relevant material property 1 mark for relevant justification **Indicative content:** Performance characteristics of stainless steel Mechanical Properties Hardness – makes chosen metal suitable as the surface is resistant to scratching from cutlery, dishes, cleaning etc Toughness – will not shatter if a pan is dropped in it Malleability – can be press formed into the shape of the sink Physical properties Resistance to corrosion – will not rust or degrade from contact with water Chemical resistant – will not degrade with detergents	**8** marks	

02					**4** marks	
		70 to 75 = 10	1 mark			
		75 to 85 = 38	1 mark			
		85 to 90 = 30				
		90 to 100 = 12				
		Answer = 75 to 85	1 mark			
		Total number of users	10+38+30+12 = 90	1 mark		

03		One mark for a definition of the term One mark for an appropriate example Indicative content: Fabrication involves joining separate pieces of material to make a complete product. Examples include: • Welding • Braising • Soldering • Riveting	**2** marks	

04		<table><tr><td>5 – 6 marks</td><td>The response demonstrates excellent analysis and compares the two chairs in detail with reference to characteristics such as: physical and mechanical properties, working characteristics, manufacturing methods. The response provides detailed evaluation of the suitability of each in the context of long-term use in an outdoor environment and draws a justified conclusion.</td></tr><tr><td>3 – 4 marks</td><td>The response demonstrates analysis and makes some comparison between the two chairs with reference to characteristics such as: physical and mechanical properties, working characteristics, manufacturing methods. The response draws upon this analysis to evaluate the suitability of each in the context of long-term use in an outdoor environment and draws a conclusion.</td></tr><tr><td>1 – 2 marks</td><td>Response provides a basic comparison of the two chairs with reference to their characteristics. The response is descriptive rather than evaluative and a conclusion may not be drawn.</td></tr><tr><td>0</td><td>No credit-worthy points</td></tr></table> **Indicative content:** Polymer garden chair: • Manufactured by one piece redistribution • Self-finished material, requiring no additional processing which may peel or chip • UV stabilisers can be added to prevent colour degradation and increased brittleness • Colour all through the plastic – makes scratches less obvious	**6** marks	

		• not affected by frost, moisture, fungal or insect attack – non porous • lightweight material, easier to store/move Wooden fabricated hardwood chair • hardwood eg teak contains natural oils which prevent decay • polyurethane waterproof varnish • micropourous finish can be added • finish has to be reapplied on a regular basis • timber could be pressure treated with chemical preservatives, increasing longevity • wood preservatives can have a combined stain or colour to improve aesthetics • susceptible to insect attack • Award any other valid response		

05		Marks awarded for maths knowledge and understanding relating to numbers and trigonometry. Marks should be allocated for the separate elements of the question as follows: • description of the manufacturing process required to prepare and assemble the lengths of timber in order to achieve the final outcome (9 marks) • the calculations required to ensure that the correct lengths of timber are used in the final construction (4 marks) • giving the minimum total length of timber required to manufacture the table legs (1 mark). **Manufacturing process (9 marks):** 7 – 9 marks: Detailed understanding of the initial design and manufacture process with knowledge of the use of correct tooling. Complete, accurate description of production methods used together with a clear understanding as to how the separate pieces of timber form the final outcome. 4 – 6 marks: Good understanding of the designing and making process with reference to tooling mostly correct. Good understanding of how final assembly is undertaken. 1 – 3 marks: Basic application of knowledge demonstrated. Response lacks detail. Some reference to incorrect tooling or no named tooling. Lack of clarity in terms of the final assembly. 0 marks: No credit worthy points or incorrect process. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Other relevant material not suggested below must also be credited**.** **Indicative content:** • Marking out lengths for table top parts with try square and ruler. • Cutting the table top planks to length, using a hand saw or similar manual tool. • Marking out of the cross halving (or similar) joint in legs. • Marking out cross members for table top under supports. • Cutting out and joining supports. • Sanding all parts to smooth, electric hand held sander, varying degrees of sanding paper or similar.	**14** marks	

- Attaching table top planks to legs (various methods may be proposed).
- Clear understanding of individual cuts of timber and how they tessellate when marked out

- Award any other valid response

Mathematical calculations (5 marks):

Leg calculation (Pythagoras) 700^2+600^2 =850000 $\sqrt{850000}$ = 921.95… Length of AB = 921.95mm	1 mark
Length of single piece of wood = 4 x 921.95 + extra piece at the end Tan49 = 25/extra piece at the end	1 mark
Extra piece at the end = 25/Tan 49 = 21.73…	1 mark
Length of leg = 921.95… + 21.73… = 943.69… mm	1 mark
Minimum total length of timber = 4 x 921.95 +21.73 = 3687.80 + 21.73 = 3709.53mm Accept appropriate rounding eg 3710mm	1 mark (allow carry forward of incorrect leg length)

Award a maximum of 2 marks if answer given does not include length of extra piece of wood required

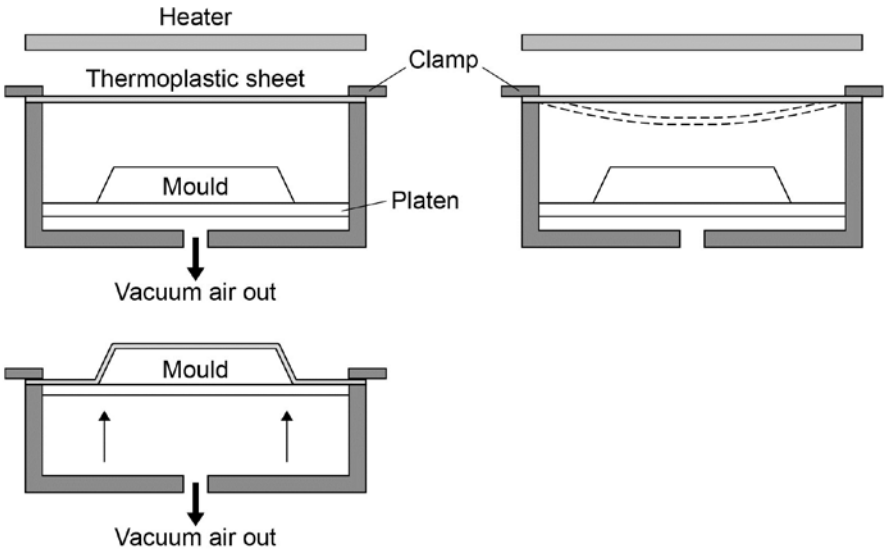
06		One mark per correct feature Indicative content: • Rounded corners • Draft or angle sides • Smooth surface • Lack of undercut • Vent holes in recesses	**3** marks	

07			**6** marks	

5-6 marks	Both a diagram and a description of the process are included. The description of the process is detailed with the use of correct terminology. The diagram of the process is complete and accurate and demonstrates knowledge of the vacuum forming process.
3-4 marks	Description of the process with some attempt at linking stages in the correct order. Diagrams mostly complete and correct.
1-2 marks	Description of the process lacks detail. Diagrams are basic with incomplete parts. Only one of either a diagram or description is included.
0	No credit worthy points. Incorrect process.

Indicative content:
Vacuum forming

For award of credit, the diagram must demonstrate knowledge of the stages of the vacuum forming process and the position of the mould, vacuum and heat source. Flow charts are not accepted.



Description:
Stage 1- The mould is placed on the machine bed.
Stage 2- A sheet of plastic is clamped onto the machine.
Stage 3- A heating element is moved over the sheet.
Stage 4- the heat softens the sheet and it begins to sag.
Stage 5- The mould is moved up into the soften sheet and the vacuum is switched on to draw the plastic around the mould.
Stage 6- The plastic is left to cool slightly.
Stage 7- The mould is removed from the plastic and the excess plastic is trimmed to size.

- Award any other valid response

8.1		Answer: £337.80			**4** marks	
		(200 x 200 x 50) - (150x150x25) = **1437500 mm^3**	M3 3 method marks	The candidate subtracts the main recess volume.		
		1437500 – (π x12.5^2) x 25 = **1425228 mm^3**		The candidate subtracts the volume of the through hole using volume of a cylinder formula.		
		1425228 mm^3 = **0.001425228m^3**		The candidate successfully converts the volume from mm^3 to m^3.		
		0.001425228**m^3** x 1580 x150 = £337.80	M1 (Method mark)	The candidate calculates the correct cost for 150 lamp bases.		

8.2

Up to 3 marks for forming process description

3 marks	Student gives a full and detailed description of an appropriate forming process
2 marks	Student gives a general description of an appropriate forming process which contains some detail
1 mark	Description of forming process is vague and lacking in detail
0 marks	Nothing worthy of credit

Up to 3 marks for accurate calculation of the tube length as shown in the table below

Forming process (3 marks):

The response should describe how the tube is bent round a former with either:

- A lever and manual force to push it.- making reference to mechanical advantage, the thickness of the tube, the length of the lever required, crushing and springback

  Or
- Using a CNC tube bender – making reference to the programming that would be required, the preparation of the material and the subsequent inspection process in order to determine accuracy.

Mathematical calculations (3 marks):

Length of arc = $2\pi r/4$	M1 (Method mark)
Length of arc = 2π x 100/4 = 157.07… mm	M1 (Method mark)
Length of tube = 300 + 50 + 157.07… =507mm	M1 (Method mark) (allow carry forward of incorrect arc length)

6 marks

8.3		Answer: 181.05mm			**3** marks	
		tan10=x/150 150tan10=x tan20=y/150 150tan20=y	M1 (Method mark)	The candidate uses trigonometry to calculate the length of AB		
		(150tan10)+(150tan20)+ 100 = Length A	M1 (Method mark)			
		Answer: 26.45 + 54.6 + 100 = 181.05mm	A1 (Accuracy mark) Award mark if given to nearest whole mm			

9		1 mark for each correctly identified speed using the correct units. Calculation:		**2** marks	
		Acrylic (1 mark)	Perimeter of shape = 1000mm =1 metre every 5 minutes =0.2 metres every minute = 0.0033 metres per second **0.0033 metres per second**		
		Plywood (1 mark)	=0.0033 ÷ 1.15 = 0.003795 **0.0038 metres per second**		

10

12 marks

9-12	The response demonstrates excellent analysis and compares the two types of packaging in detail with reference to aspects such as: physical and mechanical properties, characteristics of the material used, and implications of each material for disposal of the packaging. The response provides detailed evaluation of the suitability of each in the context of soup packaging and draws a justified conclusion.
5-8	The response demonstrates analysis and makes some comparison between the two types of packaging with reference to characteristics such as: physical and mechanical properties, characteristics of the material used, implications of each material for disposal. The response provides some evaluation of the suitability of each in the context of a soup carton.
1-4	Response provides a basic comparison of the two types of packaging with reference to their characteristics. The response is descriptive rather than evaluative and a conclusion may not be drawn.
0	Nothing worthy of credit

Indicative content:
Carton

- made from laminated card
- flat card surface ideal for printing
- greater surface area for printing nutritional info and graphics.
- laminated card is compliant which can be scored/creased and cut with die cutting process
- carton is a good shape for packing and stacking/transport
- laminated card is coated with a wax or lacquer finish to protect carton in cold storage
- carton is much less heavy than tins making it easier to carry for the consumer.
- carton is easier to open than can
- carton can be crushed easily to aid disposal
- Carton does not leave sharp edges when opened.
- Carton uses less energy to manufacture than steel can
- Carton is not easy to recycle due to difficulty cleaning.

Metal soup can

- Tin can is easily sorted and recycled as it is magnetic
- Tin plating prevents corrosion and prolongs life of the can.
- Cans are heavy and can be dented if dropped.
- Although fitted with a ring pull, the can is not easy to open for elderly/arthritic users.
- The can does not have a large surface area for printing.
- Can shape allows for stacking and large quantity can be stacked without crushing.

- Award any other valid response

11			**6** marks	

5-6	An appropriate printing process is stated. Response demonstrates understanding of paper printing processes, giving 3 – 4 explained points, referencing quality, cost and economies of scale.
3-4	An appropriate printing process is stated. Response demonstrates some understanding of paper printing processes, giving 1 – 2 relevant explained points
1-2	An appropriate printing process is stated but there is reference to only one point to explain why this is suitable
0	Nothing worthy of credit

Indicative content:

- Digital printing (Also accept inkjet or laser colour)
- High quality/consistent colour reproduction
- Speed- required for mass production
- Economies of scale- high initial set up cost vs number manufactured.
- Increased flexibility of the process compared to other methods eg offset lithography
- No specific tooling required
- Fast set up
- Colours can be adjusted
- Ease of printing/modifying
- Specialist equipment is not needed
- Offset lithography is not a suitable process due to the small size of the print run

- Award any other valid response

12		<table><tr><td>5-6 marks</td><td>Excellent response giving 3-4 explained and relevant points linked fully to product development in an industrial context.</td></tr><tr><td>3-4 marks</td><td>Good response giving 2-3 explained and relevant points linked fully to product development in an industrial context.</td></tr><tr><td>1-2 marks</td><td>Basic response with a few relevant points. Less coherent and not linked well to product development in an industrial context.</td></tr><tr><td>0</td><td>Nothing worthy of credit</td></tr></table> Indicative content: • Allows modelling to test ergonomics (shape/texture/button spacing) • Hollow construction possible to test fit for circuit/battery/balance in the hand. • Model can be used to get consumer feedback • Production engineers may use model in developing tooling • Fine details such as the split lines, internal screw fixings and battery compartment can be accurately modelled and tested- impossible in Styrofoam or MDF model. • Much faster than traditional modelling in Styrofoam by hand. • Allows the use of colour pigments in the printing plastic and decals to give a realistic prototype • Award any other valid response	**6** marks	

13		One mark per relevant point Indicative content: • Can be used to get feedback from focus groups • Produces a realistic model (life size) • Allows for checking of the fit of internal electronics • Snap fittings can be modelled and tested • Prototype can be evaluated for mould design • Data can be taken for manufacturing mould • Allows for checking of the fit against other standardised components • Cost effective	**3** marks	

14

7-9	A detailed answer with excellent demonstration of knowledge and understanding of anthropometrics and ergonomics and how they relate to product development. The answer will make a clear distinction between anthropometrics and ergonomics and how they have been considered in the design of the product.
4-6	A good answer with good demonstration of knowledge and understanding of anthropometrics and ergonomics and how they relate to product development. Answer may describe features of the product rather than explaining how anthropometrics and ergonomics have influenced its design.
1-3	Basic answer with only a limited number of relevant points. Answer will be mostly descriptive and there may be confusion between anthropometrics and ergonomics.
0	Nothing worthy of credit

9 marks

Anthropometrics

- Use of palm line to determine length of remote
- Finger sizes to determine size of buttons and spacing
- Average grip size to determine width and suitable depth of remote

Ergonomics:

- Use of colour on the most frequently used buttons
- Key buttons such as volume and channel are larger
- Use of ideograms on buttons- allows ease of use without referring to instructions
- White text/ideograms on black background easy to read
- Possible shaping of the back of the remote to aid grip
- May make reference to the potential use of TPE/LSR to make a textured grip, or ridges moulded into surface
- Use of spring loaded catch on battery compartment with space for finger nail.
- Buttons should not be recessed

- Award any other valid response

15		Two marks for the correct definition of a composite material. One mark for a basic response. Indicative content: A mix of two or more material to produce a material with enhanced properties A mix of two or more materials to create a new material	**2** marks	

16		One mark for naming a suitable composite material. Indicative content: CFRP (1 mark) GRP (1 mark)	**1** mark	

17		One mark per correct stage in the lay-up process Stage 1: Mould creation Stage 2: Add release agent Stage 3: Add gel coat (with pigment) Stage 4: Layer fibres and resin Stage 5: Remove air bubbles Stage 6: Leave to cure and trim edges • Award any other valid response	**6** marks	

18

Mark	Description
10-12	This student will exhibit detailed awareness of social, moral and ethical issues. The discussion will fully analyse and evaluate many of the factors relating to manufacture and how they contribute to each other. The student will evaluate ways in which a product designer can both damage and contribute positively to the issue.
7-9	Discussion highlights many social, moral and ethical factors facing a designer today, the student will analyse and evaluate ways in which a product designer can both damage and contribute positively to the issue. However, may only make some links between issues.
4-6	Discussion highlights some social, moral and ethical factors facing a product designer today. Limited analysis and evaluation of the ways in which a product designer can both damage and contribute positively to this issue.
1-3	Weak discussion which lacks clarity about social, moral and ethical factors facing a product designer today. There may be a lack of information and some of the points may be confused with one another. Some analysis present but no evaluation or conclusions drawn.
0	Nothing worthy of credit

12 marks

Indicative content:

The answer may include some of the following factors:

- The development of products that are culturally acceptable, that will not offend people of different race, gender or religious belief.
- Designing products that will be made without the use of child labour and using safe working practices.
- A knowledge and understanding of the impact of the manufacture, use and disposal of products on the environment.
- Selection of materials that are not damaging to the environment
- Choosing sustainable raw materials
- Product longevity vs throwaway products
- Not harming wildlife/environment
- Sustainable forms of power
- Energy consumption during manufacture and the life of the product
- Inclusive design
- Consideration of 6 R's
- Safety legislation
- Manufacturing conditions for employees

		• Award any other valid response		

19		<table><tr><td>4-5 marks</td><td>A detailed response which demonstrates excellent understanding of material properties and working characteristics and explains in detail the benefits of using a smart material in the context of the product function.</td></tr><tr><td>2-3 marks</td><td>A good answer which demonstrates good understanding of material properties and working characteristics of smart materials and explains some benefits of using a smart material in the context of the product function.</td></tr><tr><td>1 mark</td><td>A basic answer with only one relevant point regarding the benefits</td></tr><tr><td>0</td><td>Nothing worthy of credit</td></tr></table> **Indicative content:** Polymer with a smart material advantages • Changes colour with heat which is a safety feature. The user will know the spoon is hot by the colour change, the metal spoon stays the same colour hot or cold. • The colour change with heat indicates the food is too hot for the baby. With the metal spoon the user may taste the food on their mouth first, thus transferring germs to the baby. • The colour change shows the spoon is hot but polymer is an insulator so the user will not get burned. The metal spoon stays the same colour so the user does not know if the spoon is hot or cold. • The thermochromic pigment can be integrated within the single injection moulding process, to transform the metal spoon into a colour changing spoon the thermochromic pigment would have to be applied after the spoon is manufactured, as an additional process. • Award any other valid response	**5** marks	