GCSE

Design and Technology: Resistant Materials

Mark scheme

45601

June 2015

V1 Final Mark Scheme

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

1	**a**		Give **three** design requirements of a task light for use on a home office desk or student desk. Explain each of your answers. Award 1 mark for a correct Requirement and up to 2 marks for a correct Explanation. Note: Each Requirement numbered below corresponds with the equivalently numbered Explanation. Candidates may gain marks for a correct Explanation even if the Requirement is incorrect. Candidates may also give you both the Requirement and the Explanation in one part of their answer. Do not award a mark for a repeat the design brief or the given example. Any correctly identified requirement. Possible responses: 1. It should confine the light to the work area 2. It should be easy to change the direction of the light 3. It should be capable of being manufactured in quantity 4. It should be safe to use 5. It should ergonomically designed 6. It should be stylish/unique/modern 7. It should be compact 8. It should be environmentally friendly 9. You should be able to carry out simple maintenance on the light source 10. It should be durable/robust (1 x 1 mark) Any relevant explanations Note: Remember there are 2 marks for each explanation. You are looking for a statement **and** a qualification. Note: Each Requirement numbered below corresponds with the equivalently numbered Explanation. Candidates may gain marks for a correct Explanation even if the Requirement is incorrect. Candidates may also give you both the Requirement and the Explanation in one part of their answer. Do not award a mark for a repeat the design brief or the given example. Possible responses: 1. Because this will help the user to see what they are doing **such as** working on their laptop 2. Because the light may be needed in other areas **such as** reading a magazine 3. Because making things in bulk reduces the unit cost **as** you can buy	

			raw materials cheaper 4. Because no one should be injured when using the device. No one would buy the product if it was unsafe. 5. Because it should be easy **and** comfortable to use. 6. Because this will suit a modern work area. It will be more appealing to students if has a modern look. 7. Because it should not take up too much room on the desk. This will allow a greater workspace. 8. Because we should reduce the amount of non-renewable materials we use. This will help to minimise climate change. 9. Because it is cost efficient to just change the light source when it has broken **rather than** replace the whole light. 10. Because it will be need to be manipulated by clumsy teenagers. Customers will not be satisfied with a lamp that breaks easily. (2 x 1 mark)	**3 marks**
1	**b**		Award 1 mark for a correct Requirement and up to 2 marks for a correct Explanation. Any correctly identified requirement. Possible responses: 1. It should confine the light to the work area 2. It should be easy to change the direction of the light 3. It should be capable of being manufactured in quantity 4. It should be safe to use 5. It should ergonomically designed 6. It should be stylish/unique/modern 7. It should be compact 8. It should be environmentally friendly 9. You should be able to carry out simple maintenance on the light source 10. It should be durable/robust (1 x 1 mark) Any relevant explanations Note: Remember there are 2 marks for each explanation. You are looking for a statement **and** a qualification. Note: Each Requirement numbered below corresponds with the equivalently numbered Explanation. Candidates may gain marks for a correct Explanation even if the Requirement is incorrect. Candidates may also give you both the Requirement and the Explanation in one part of their answer. Do not award a mark for a repeat the design brief or the given example. Possible responses: 1. Because this will help the user to see what they are doing **such as**	

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1	**c**		Award 1 mark for a correct Requirement and up to 2 marks for a correct Explanation. Any correctly identified requirement. Possible responses: 1. It should confine the light to the work area 2. It should be easy to change the direction of the light 3. It should be capable of being manufactured in quantity 4. It should be safe to use 5. It should ergonomically designed 6. It should be stylish/unique/modern 7. It should be compact 8. It should be environmentally friendly 9. You should be able to carry out simple maintenance on the light source 10. It should be durable/robust (1 x 1 mark) Any relevant explanations Note: Remember there are 2 marks for each explanation. You are looking for a statement **and** a qualification. Possible responses: 1. Because this will help the user to see what they are doing **such as** working on their laptop 2. Because the light may be needed in other areas **such as** reading a magazine	

			3. Because making things in bulk reduces the unit cost **as** you can buy raw materials cheaper 4. Because no one should be injured when using the device. No one would buy the product if it was unsafe. 5. Because it should be easy **and** comfortable to use. 6. Because this will suit a modern work area. It will be more appealing to students if has a modern look. 7. Because it should not take up too much room on the desk. This will allow a greater workspace. 8. Because we should reduce the amount of non-renewable materials we use. This will help to minimise climate change. 9. Because it is cost efficient to just change the light source when it has broken **rather than** replace the whole light. 10. Because it will be need to be manipulated by clumsy teenagers. Customers will not be satisfied with a lamp that breaks easily. (2 x 1 mark)	**3 marks**

2	**a**		Use the information in the Design Brief on page 2 and your answers in Question 1, to help you sketch **two** different design ideas for a task light. The task lights do **not** need to be adjustable Marks will be awarded for creativity. (2 x 3 marks) Mark each idea out of 3 using the following scale: • A repeat idea 0 mark • A simple idea that provides light 1 mark • An idea that provides light. It displays some originality or additional design features. E.g. large base, unique shade. 2 marks • An original idea that provides light. It displays several creative design features and ergonomics has been considered. 3 marks Exemplar material	**2 x 3 marks**

2	**b**		Use the information in the Design Brief on page 2, and your answers in question 1 to help you to sketch **three** different ideas for an adjustable task light. Each of your ideas should use a different method of adjustment Marks will be awarded for creativity. (3 x 3 marks) Note: If the candidate has given details of how the brightness of the light can be adjusted award it as a correct response. Mark each idea out of 3 using the following scale: • A repeat idea *0 mark* • A simple adjustable idea that provides light. *1 mark* • An adjustable idea that provides light. It displays some originality or additional design features. E.g. large base, unique shade. *2 marks* • An original adjustable idea that provides light. It displays several creative design features and ergonomics has been considered. 3 *marks* Note: Each idea must have a different method of adjustment to be awarded marks. Exemplar material	**3 x 3 marks**

3			Choose your best idea from Question **2 (b).** On pages 6 and 7, show how you would develop your design use notes and sketches. Marks will be awarded for: • details of a specific material and a suitable finish (explain your choices) **[2 marks]** • constructional details **[3 marks]** • design features and sizes **[3 marks]** • details of your chosen method of adjustment. **[3 marks]** Development details could include: **Materials and finish** • One or more specific material(s) identified **and** justified. 1 mark • One or more relevant finish(es) identified **and** justified 1 mark **Construction** Award up to three marks for constructional details • A simple reference to a method of construction 1 mark • A outline of a method of construction 2 marks • Detailed information relating to a method of Construction 3 marks **Design features/sizes** Award one mark each for details relating to two design features. E.g. wide base, adjustment, unique shade, ergonomic features. Award one mark each for two relevant sizes. Note: All dimensions should be in mm unless otherwise stated. Imperial measurements are acceptable. All dimensions should be realistic to be awarded a mark *(Max 3 marks)* **Adjustment** Award up to three marks for details of a method of adjustment • A simple reference to a method of adjustment 1 mark • A outline of a method of adjustment 2 marks	

			• Detailed information relating to a method of adjustment 3 marks **Adjustment (lighting)** Award up to three marks for details of a method of adjusting the lighting • A simple reference to a method of adjusting the light 1 mark Some details of the electrical components 2 marks • Detailed information electrical circuit 3 marks	**11 marks**

4			Use notes and sketches to show how you would make **one** Year 11 inter-house football trophy in a school workshop. At each stage, name **all** the tools, equipment and/or software you would use. Award marks using the following descriptors **Stage 1: How to make parts A and B (Traditional)** Sufficient detail for most of the design to be made by a third party. Award up to 2 marks for details of marking out: Look for information relating to the use of: • Pencil • Rule • Tri square • Compass/dividers • Template Award up to 2 marks for details of shaping: Look for information relating to the use of: • Tenon/Hegner/band/scroll saw • Wood lathe • Plane/disc sander/band facer **Max 4 marks** **Or** **Stage 1: How to make parts A and B (CAD/CAM)** Sufficient detail for most of the design to be made by a third party. Award up to 2 marks for details of CAD: Look for information relating to the use of: • Naming a suitable software program e.g. 2D design/AutoCAD/ProDesktop/Solid Works • Drawing on screen Note: a list of marking out tools Award up to 2 marks for details of shaping:	

			Look for information relating to the use of: • 3D/CNC router/Laser **Stage 2: How to join parts A and B (Traditional)** Sufficient detail for most of the design to be joined by a third party. Possible methods: Butt joint Screwed joint Dowel joint Housing Mortise and Tenon Award up to 4 marks for details of how to produce the chosen method of joining using the following mark descriptors: A suitable method of joining identified 1 mark A suitable method of joining identified and details one of the following given: marking out, cutting or fixing. 2 marks A suitable method of joining identified and details two of the following given: marking out, cutting and fixing. 3 marks A suitable method of joining identified and details of all of the following given: marking out, cutting and fixing. 4 marks **Or** **Stage 2: How to join parts A and B (CAD/CAM)** Sufficient detail for most of the design to be joined by a third party. Possible methods: Mortise and tenon Housing Award up to 4 marks for details of how to produce the chosen method of joining using the following mark descriptors: A suitable method of joining identified 1 mark A suitable method of joining identified and details one of the following given: The joint designed on a software package, cutting on a 3D/CNC Router or fixing. 2 marks	

			A suitable method of joining identified and details two of the following given: The joint designed on a software package, cut on a 3D/CNC Router or fixed. 3 marks A suitable method of joining identified and details of all of the following given: The joint designed on a software package, cut on a 3D/CNC Router and fixed. 4 marks **Stage 3: How to produce the mould and cast Part C** Award up to 6 marks for details of how to cast using the following mark descriptors: Brief details of mould production and the casting process 1– 2 marks Details of some of mould production and the casting process given 3 – 4 marks Details of most stages of mould production and the casting process given 5 – 6 marks Possible methods: **Pewter casting** Look for details relating to: • Marking out the mould – traditional or CAD • Making the mould - cutting using hand tools/laser/router. • Heating the pewter- brazing torch/hot air gun • Pouring the metal – ladle/spoon • Health and safety issues – leather apron, gloves, sand box **Aluminium casting** Look for details relating to: • Marking out the pattern – traditional or CAD • Making the pattern - cutting using hand tools/laser/router. • Making the mould - cope and drag, sand, runner and riser gates • Heating the aluminium - furnace • Pouring the metal • Health and safety issues – leather apron, gloves, sand box No marks to be awarded for any other fabrication method. E.g. Sawing and filing	**14 marks**

<table>
<tr><td>5</td><td>a</td><td></td><td>
<table>
<tr><th>Fastening</th><th>Name</th><th>Function</th></tr>
<tr><td>  </td><td>Washer</td><td>A washer spreads the pressure and protects the surface of the material.</td></tr>
<tr><td> 
Award 1 mark for a drawing of a bolt</td><td>Bolt</td><td>Award up to 2 marks for any of the following:
• A temporary fixing
• Used with a bolt
• Fastens components together</td></tr>
<tr><td>  </td><td>Award 1 mark for: nut

Award 2 marks for: ‘nyloc’ / anti vibration nut</td><td>Award up to 1 mark for any of the following:
• A temporary fixing
• Used with a bolt
• Fastens components together

Award up to 1 mark for the following:
• Nylon insert prevents the nut working loose</td></tr>
</table>
</td><td>7 marks</td></tr>
<tr><td>5</td><td>b</td><td></td><td>Give a use for each of the following adhesives.
Give two advantages and one disadvantage of using this adhesive.

Polyvinyl acetate (PVA)

Award 1 mark for any of the following uses:
• Gluing wood to wood
• Gluing paper products together

Award one mark each for any of the following two advantages:
• It is very strong
• It has a relatively long ‘slip’ time
• It is ready to use from the bottle
• It is environmentally friendly</td><td></td></tr>
</table>

			• It dries clear • It is relatively inexpensive • Cost effective Award one marks for any of the following disadvantages: • It takes a long time to dry • It is not waterproof • It can only glue wood based/porous materials **Cyanoacrylate (Super Glue)** Award **one** mark for gluing any named, resistant material to any named, resistant material Award up to **two** marks for any of the following advantages: • It dries very quickly • It is strong • It dries clear • It can be used to glue almost any resistant material together Award one mark for any of the following disadvantages: • There is no 'slip' time • It is harmful to the environment • It is an irritant • It is harmful to humans • It is expensive	**8 marks**
5	**c**		Use notes and sketches to show how you would glue two materials together using epoxy resin. Award up to **five** marks for details of how to use epoxy resin to glue two materials together using the following mark descriptors: Brief details of the gluing process 1 – 2 marks Details of most of the gluing process 3 – 4 marks A complete sequence of the gluing process 5 marks Look for details relating to: • Preparing the surface – cleaning/degreasing • Keying the surface • Reference to the two part adhesive • Mixing equal amounts of adhesive • Apply the adhesive • Clamping and cleaning the joint	**5 marks**

6			Explain the advantages and the disadvantages of using a cordless drill/driver rather than a screwdriver. Award marks for details relating to advantages and disadvantages of using a cordless drill/driver rather than a screwdriver. Candidates can get one mark for stating an advantage/ disadvantage and a second mark for explaining the advantage/disadvantage. Mark the candidates answer on its technical merit first, then, apply the QWC descriptors. This may increase or decrease the candidate's marks by 1 or 2 marks depending on the quality of the QWC. Note: Candidates must address advantages and disadvantages for 8 marks. If a candidate fails to address both aspects then they can only score a maximum of 7 marks. Possible responses: Advantages: • Less effort is required to screw in screws ○ The motor does the work for you • Greater torque/Tighter screws ○ The motor delivers more power than a person can • Adjustable torque ○ You can set the torque so that small screws are not destroyed • Magnetic ○ This makes it easier to screw in awkward places • Versatile/interchangeable bits/drill ○ You can change the bit to match the type of screw ○ You can use it as a drill • Ergonomic ○ It has lots of moulded/high friction/colour coded areas Disadvantages • Expensive ○ A cordless drill driver is far more expensive to buy than a screwdriver • Bulky ○ The cordless drill driver takes up room in a toolbox/has to have its own box/is difficult to carry around • Battery needs charging ○ The battery may run out during use ○ You need to have access to mains electricity • Not environmentally friendly ○ It uses more materials and requires more manufacturing processes to make. The batteries need mains electricity to recharge	

			A detailed and comprehensive response that includes several of the examples above. The answer is well-structured, with good use of appropriate design & technology terminology and showing a good grasp of grammar, punctuation and spelling.	7 - 8 marks	
			A fairly detailed response which refers to some of the examples above. The answer is fairly well structured, with some use of design & technology terminology and with a small number of errors in grammar, punctuation and spelling.	5 - 6 marks	
			A response which contains a one or two of the examples above. The answer has some structure, with some use of design & technology terminology and with a number of errors in grammar, punctuation and spelling.	3 – 4 marks	
			A response which contains very limited reference to any of the examples above. The answer is vague or poorly structured, with little use of design & technology terminology and with a considerable number of errors in grammar, punctuation and spelling.	1 - 2 marks	
			A response which is poorly structured with no relevant examples. There is very little or no use of design technology terminology and with many errors in grammar, punctuation and spelling.	0 marks	**8 marks**

<table>
<tr>
<td>7</td>
<td>a</td>
<td>i</td>
<td>Explain what is meant by the term ‘smart’ material

Award up to 2 marks using the following criteria:

A brief answer 1 mark
A detailed response 2 marks

Look for details relating to:

• A material that changes due to external stimuli
• Such as temperature change
• Changes in lighting
• Electrical impulse</td>
<td>2 marks</td>
</tr>
<tr>
<td>7</td>
<td>a</td>
<td>ii</td>
<td>Award one mark for each correct response:
Possible responses:

<table>
<tr><th>Product</th><th>Material</th></tr>
<tr><td>Spectacles
Dental braces

(1 mark)</td><td>Shape memory alloys (SMA)
‘Nitinol’</td></tr>
<tr><td>A baby’s feeding spoon that changes colour if the food is too hot.</td><td>Thermochromatic pigment
(plastic) (polymer) (paint)
(1 mark)</td></tr>
<tr><td>Soft closing doors/draws/toilet seats/volume control knobs
(1 mark)</td><td>Motion control gel
‘Smart grease’</td></tr>
</table>
</td>
<td>3 marks</td>
</tr>
<tr>
<td>7</td>
<td>b</td>
<td>i</td>
<td>Explain what is meant by the term nanomaterial

Award up to 2 marks using the following criteria:

A brief answer 1 mark
A detailed response 2 marks

Look for details relating to:

• A material that contains nanoparticles/tubes
• A material has improve mechanical properties
• A material that has an average particle size of between 1 and 100 nanometres</td>
<td>2 marks</td>
</tr>
</table>

7	**b**	**ii**	Name a product that uses a nanomaterial. There are over 800 registered everyday products that incorporate nanomaterials. Award up to 1 mark for a product that uses nanomaterials. . Possible responses: • Coatings: Paint, glass, computer/camera/ phone displays • Sporting equipment: Golf clubs, tennis racquets, lacrosse sticks, socks • Automotive industry: Car bumpers/paint 1 mark Describe the advantages of using this material. Award up to 2 marks using the following criteria: A brief answer 1 mark A detailed response 2 marks Look for details relating to a product being: • Stronger • Lighter • More durable • Stiffer • More flexible • More reactive	**3 marks**
7	**c**		Name a composite material used for the body of an F1 racing car. Explain why this material has been used. Award 1 mark for any of the following materials: Possible responses: • Kevlar • Carbon Fibre • GRP/Fibre glass Award 1 mark for a correct explanation Possible responses: • It is strong • It is stiff • It is lightweight • It can be moulded into shape	**2 marks**

8 **a**

Complete the table by:

- stating the meaning of each sign
- naming an activity where you would need to follow the advice of this sign
- identifying the hazard

Sign	Meaning	Process	Hazard
	*Safety glasses must be worn*	Any process that may cause damage to the eyes: Using power tools Sanding Using adhesives (1 mark)	Your eyesight could be damaged (1 mark)
	Safety gloves must be worn *(1 mark)*	*When handling hot metal or carrying sharp objects*	*Your hands could be burned/cut* *(1 mark)*
	Ear defenders must be worn. Accept 'plugs' but not 'muffs' *(1 mark)*	When using loud machinery or when working in a noisy environment *(1 mark)*	*You could damage your hearing*
	A dust mask must be worn. Accept mask but not 'gas' mask *(1 mark)*	Any process that may cause damage to the respiratory system: Using power tools Sanding Using adhesives *(1 mark)*	Your respiratory system/lungs/breathing could be damaged *(1 mark)*

9 marks

8	**b**	**i**	Study the symbol show below  Name the type of product that would display this symbol. Award a mark for any reference to a product suitable for a child. Note: Accept non Resistant Material answers. Possible responses: • a child's toy • a train set • a teddy bear	**1 mark**
			Explain the importance of this symbol to the consumer. Award marks for details relating to the importance of the symbol or similar 'standard' symbols, to the consumer. Candidates can get one mark for stating an important fact and one mark for explaining it. Note: This part of the question can relate to the use of any 'standard' symbol. Possible responses: The consumer knows that a product bearing the 'standard' symbol; • has been tested ○ and is therefore safe for the child to play with • is of a high quality ○ and therefore will last a long time/will not break • has been ethically produce ○ therefore no one has been exploited in its manufacture • has been produced using sustainable methods ○ therefore it will have minimal effect on the environmental • is educational ○ therefore the child will learn by playing • is not counterfeit ○ it is a genuine product	**7 marks**

9	**a**	**i**	Name a suitable finish for the pine table. Award 1 mark for a correct response: Possible responses: • Varnish • Wax • Danish / Teak oil • French polish • Shellac	**1 mark**
9	**a**	**ii**	Give **two** reasons for why you have chosen the finish you have named in (ai). Look for details relating to: • It enhances the look of the table • It brings out the look of the grain • It gives provides a shiny finish • It provides it with a water resistant finish • It gives a smoother finish • It helps protect the table	**2 marks**
9	**b**	**i**	Name a suitable finish for the mild steel hook. Award 1 mark for a correct response: Possible responses: • Paint • Spray paint/Car spray paint/Cellulose spray paint • 'Hammerite' paint • Plastic dip (coating) • Powder coating • Galvanising/Zinc coating • Plating • Lacquer Note: Do not award marks for buffing/polishing	**1 mark**
9	**b**	**ii**	Explain why the mild steel hook requires a finish Award up to 2 marks using the following criteria: A brief answer 1 - 2 mark A detailed response 3 – 4 marks	

			Look for details relating to steel: • Because it will rust if not protected • Because its appearance will deteriorate if not protected • Because it will weaken if not protected • Because it is cold to the touch • Because it will stain clothing if not protected • Because it does not look appealing without a finish • Because last longer if protected • Because it will look better if a finish is applied	**4 marks**

9	**b**	**iii**	Use notes and sketches to describe how you would apply the finish you have named in (bi). Award marks using the fooling criteria: Limited details of how to apply the finish. 1 – 2 marks Some details give of how to apply the finish 3 – 4 marks Most details give of how to apply the finish 5 – 6 marks Look for the following details: Reference to buffing and polishing is to be awarded 1 mark as part of the preparation process. Gloss painting • Cleaning with an abrasive paper (emery cloth/wet and dry paper) • Degreasing (Turps/white spirit) • Cleaning (washing/wiping) • Applying a primer coat • Flattening down (wet and dry paper) • Applying a gloss coat • Brush cleaning Spray painting • Cleaning with an abrasive paper (emery cloth/wet and dry paper) • Degreasing (Turps/white spirit) • Cleaning (washing/wiping) • Applying a primer coat • Flattening down (wet and dry paper) • Applying a gloss coat • Use of extraction equipment/spray booth/mask • Nozzle cleaning 'Hammerite'	

			• Cleaning with an abrasive paper (emery cloth/wet and dry paper) • Degreasing (Turps/white spirit) • Cleaning (washing/wiping) • Applying 'Hammerite' (brush) • Brush cleaning Plastic dip (coating) • Cleaning with an abrasive paper (emery cloth/wet and dry paper) • Degreasing (Turps/white spirit) • Cleaning (washing/wiping) • Heating (kiln/oven) • Dipping (fluidising bath) • Cooling • Health and safety	**6 marks**