



**GCSE**

## **Design and Technology: Resistant Materials**

Unit **A565**: Sustainability and technical aspects of designing and making

General Certificate of Secondary Education

**Mark Scheme for June 2018**

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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**Annotations**

<b>BOD</b>	BOD	Benefit of doubt	Use as appropriate
<b>L1</b>	L1	Level 1	Use in banded mark scheme response only
<b>L2</b>	L2	Level 2	Use in banded mark scheme response only
<b>L3</b>	L3	Level 3	Use in banded mark scheme response only
<b>REP</b>	REP	Repeat	Use when response is restating the same point
<b>SEEN</b> <b>BP</b>	SEEN / Blank Page	Noted but no credit given	Do not use instead of a cross for a wrong answer
	Tick	Tick	Ticks must be equal to the number of marks given. Do not use in banded (*) questions

**Subject-specific Marking Instructions**

Answers relating to dimensions/sizes must be in metric units.

Question		Expected Answers	Marks	Guidance
1		(b) Generating electricity	[1]	No other answer is acceptable or possible
2		(c) Reuse	[1]	No other answer is acceptable or possible
3		(c) Raw material extraction	[1]	No other answer is acceptable or possible
4		(d) Coal	[1]	No other answer is acceptable or possible
5		(a) A product has a reduced environmental impact compared to similar products.	[1]	No other answer is acceptable or possible
6		“1” represents PETE/PET OR HDPE is represented by “2”/ The number is wrong HDPE is wrong	[1]	<b>Do not accept:</b> comments about the Mobius strip (which is correct);  One of these
7		Aided	[1]	No other answer is acceptable or possible
8		Ultraviolet/UV	[1]	<b>Do not accept:</b> sun's rays/heat/IR/light
9		Photochromic/Transitions/Reactolite	[1]	<b>Do not accept:</b> smart/modern/polarising/"Smart glass" (uses electricity to change)
10		Any one from:  Incineration/combustion (accept burning).  Landfill/the dump (accept burying in the ground).  Recycling /recovery of materials.  Composting	[1]	<b>Do not accept:</b> put in bin (not a disposal method); put in sea (hardly environmentally friendly!!); rubbish bag

<b>Question</b>		<b>Expected Answers</b>	<b>Marks</b>	<b>Guidance</b>
11		False	[1]	No other answer is acceptable or possible
12		True	[1]	No other answer is acceptable or possible
13		False	[1]	No other answer is acceptable or possible
14		False	[1]	No other answer is acceptable or possible
15		True	[1]	No other answer is acceptable or possible
		<b>Total</b>	<b>15</b>	

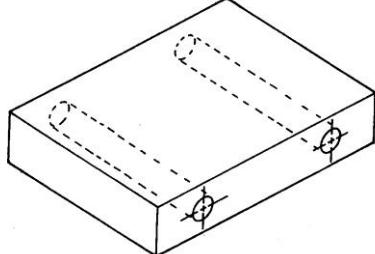
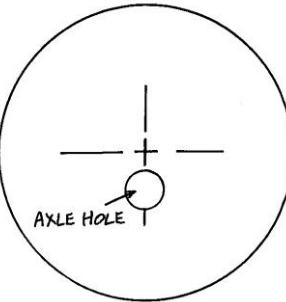
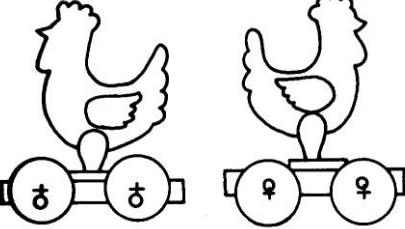
Question		Expected Answers	Marks	Guidance
16	a	Globalisation/ globalised	[1]	<b>Do not accept:</b> global/national/international
	b i	<p>The material is shaped with ridges, channels, grooves, waves or ribs (1) ... to give added strength/ denting resistance to the material (1) The material shows a regular pattern of ridges and valleys (1) Reference to "ridges like in Fig. 1" (1)</p> <p>One relevant description + one relevant property</p>	[2]	<b>Do not accept:</b> references to other materials (cardboard or plastic) for the second mark; "stronger" without proper description of the term "corrugated"
	ii	<p>Electro-plating/ galvanising/ chrome plating/plating steel with zinc gives weatherproofing/protection against the elements/weather/stops rusting/oxidation (1) ...and gives longer life to the steel/makes the steel look nice (1).</p> <p>One relevant description + relevant outcome</p>	[2]	<b>Do not accept:</b> responses relating to strengthening the steel or responses relating to gold or silver plating; references to cheap(er)/strong(er)/light(er)
	iii	<p>Mild steel is heat resistant (1) ... against hot coal fire ashes (1)</p> <p>Mild steel conducts heat (1) ... and allows the ashes to cool quickly (1)</p> <p>Cheap to produce (1) ... using tried and tested technology (1)</p> <p>Durable/robust/tough/UV resistant (1) ... doesn't split or shatter (1)</p> <p>Plastic could melt/burn from hot ashes (1)... causing spillage of hot contents (1)</p> <p>Plastic could melt/burn (1) ... from hot ashes (1)</p> <p>Mild steel easily available (1) --- scarcity of suitable plastics (1)</p> <p>One relevant description + relevant outcome</p>	[2]	

Question		Expected Answers	Marks	Guidance
c		Lightweight Non-corrodible Chemically resistant (e.g. bleach, cleaning products) Durable Water/waste/weather resistant Colourful/aesthetically pleasing Easy to clean Retains its shape/structure Does not need to withstand heat  Two relevant points 1 + 1	[2]	No explanation required here  <b>Do not accept:</b> light/strong/quick unless properly qualified; lighter than steel (is it?); can be made/moulded to be identical; easy to produce <b>Accept:</b> possible repetition of (a)iii above – award 1 mark
d		Handle (1) – large and “grippy”, makes it easy to hold (1) Wheels (1) – make it easy to move full bins around (1) Lid (1) – hinged at the back to make it easy to lift/open with one hand (1) Lid fixed at back (1) – stops lid being blown off in strong winds (1) Large handles on lid (1) – easy to lift (1) Made with a lip (1) – can be lifted by machinery (1)  One relevant feature + relevant purpose (1 + 1) x 2	[4]	<b>Do not accept:</b> references to height/bigger/heavier
e		Ergonomics	[1]	<b>Do not accept:</b> Anthropometrics <b>Accept:</b> close mis-spellings

Question		Expected Answers	Marks	Guidance
16	f*	<p><b>This is not</b> about storage of industrial waste, but of separation and storage of domestic refuse (c 430kg per person per year – 2015).</p> <p>Answers could concentrate upon one or more of the following aspects.</p> <ul style="list-style-type: none"> <li>✓ <b>Plastics are not environmentally friendly</b>, but they last a long time and are cheap/easy to replace when badly damaged.</li> <li>✓ <b>Plastics are not environmentally friendly</b> unless bio-degradable (but can't be used as rubbish bin, therefore)</li> <li>✓ <b>Plastics can be generally recycled</b> at the end of their life cycle</li> <li>✓ <b>Plastics are generally resistant</b> to weather/insect attack</li> <li>✓ <b>Plastics are easily cleaned</b> (hygienic)</li> <li>✓ <b>Plastics may be easily self-coloured</b> to identify different types of waste (green, brown, blue, etc.).</li> <li>✓ <b>If waste is not contained</b>: uncontrolled and indiscriminate disposal; soil and water contamination; environmental littering; lack of possible recycling revenue to local authority.</li> <li>✓ <b>If waste is contained by households</b>: effective sorting of different waste products; incentive to reduce amount of packaging bought/disposed; reuse as much as possible before disposal; storage in different bins for controlled and regular disposal by local authority, energy can be reclaimed from incineration.</li> <li>✓ <b>Controlled waste collection</b> and disposal reduces risk of contaminated land-fill sites.</li> </ul> <p>Answers may concentrate upon just one or two of the above aspects, or may jump from one to another. Best response will be broken down into 3 or 4 paragraphs, three majoring on one topic each, and one conclusion; not all topics need be covered.</p> <ol style="list-style-type: none"> <li>1. READ the full response and judge this in terms of the LEVEL of response (1, 2 or 3).</li> <li>2. THEN consider the quality of the “technical” content within that level to determine the final mark.</li> <li>3. IT IS POSSIBLE that the initial assessment of level will have to be modified if the technical content is poor or non-existent; e.g. if the candidate has written a good set of arguments relating to use of plastics (possible Level 3), but has not focused upon the topic in question.</li> </ol>	[6]	<p><b>Level 3 (5-6 marks)</b> Sound discussion showing understanding of the necessity of using environmentally unfriendly materials to manage our inevitable waste production. More than one specific example given and referred to. Specialist terms will be used appropriately and correctly. Answers clear and presented in a structured format. Accurate use of grammar, punctuation and spelling.</p> <p><b>Level 2 (3-4 marks)</b> Adequate discussion showing some understanding of the necessity of using environmentally unfriendly materials to manage our inevitable waste production. Just one specific example given. Answers clear and presented in a mainly structured format. Occasional errors of grammar, punctuation and spelling.</p> <p><b>Level 1 (1-2 marks)</b> Basic discussion showing little understanding of the necessity of using environmentally unfriendly materials to manage our inevitable waste production. No specific examples given. Little or no use of specialist terms. Answers ambiguous and disorganised; intrusive errors of spelling, grammar and punctuation. Bullet points do not constitute a discussion, and can only be awarded Level 1 (max. 2 marks)</p> <p><b>0 marks</b> <b>Discussion wholly outside the topic</b>, not worthy of a mark.</p>

Question		Expected Answers	Marks	Guidance
17	a	<p>Oak, ash, beech, elm, maple, teak, mahogany, any fruit wood or other suitable hardwood</p>	[1]	<p><b>Do not accept:</b> balsa, obeche, yew, pine, fir</p>
	b	<p>Hardwoods are generally decorative (1)... and painting obscures the decorative effect (1)</p> <p>Most hardwoods have a close grain (1) ... and paint doesn't stick very well (1)</p> <p>The base and wheels take most knocks (1) ... and the paint will chip off making the toy look unsightly (1)</p> <p>Ensures surfaces are easy to keep clean (1) ... without obscuring grain (1)</p> <p>Some hardwoods are oily (1) ... and paint will not stick to the wood (1)</p> <p>(Varnish) gives the wood a nice shine/finish (1)</p> <p>Varnish is non-toxic (1)</p> <p style="text-align: center;">One relevant point + one corollary (1 + 1) x 2</p>	[4]	<p><b>Do not accept:</b> Protect the wood (TV)</p>
	c i	<p>Look for:</p> <p>half size/½ size drawing</p> <p>double size/x2 of product</p> <p>e.g.</p> <p>The drawing is <b>half the size</b> (1) of the full product (1)</p> <p>Drawing is smaller (1) than <b>double size</b> product (1)</p> <p>Product will be double size (1) of drawing (1)</p> <p>Body is <b>drawn</b> 80 high (1) body will be <b>made</b> 160 high (1)</p> <p>Drawing cannot be used as a template (1)</p> <p style="text-align: center;">One relevant point + explanation</p>	[2]	<p><b>Do not accept:</b> any reference to drawing being bigger than artefact; references to number of parts to be cut</p>

Question		Expected Answers	Marks	Guidance
	ii	<p>Mark out/make template/scan drawing and enlarge</p> <p>Make all components twice the size of the drawing</p> <p>Feet – make two</p> <p>Wings – make two</p> <p>Legs – make two</p> <p>Body – make thicker/make two and glue together</p> <p>Measure twice, cut once</p> <p>Check type of material to be used</p> <p>Reference to thickness of board (e.g. body 18mm thick, other components 9mm)</p> <p>Use laser cutter</p> <p>Set speed of laser cutter</p> <p>Set power of laser cutter</p> <p>Clamp/secure board while cutting</p> <p>Cut on waste side of shape</p> <p>Use coping saw/fretsaw/Hegner saw to cut out components</p> <p>Use file to <b>shape</b> components/finish to the line</p> <p>Any four relevant points without repetition 1 x 4</p>	[4]	<p><b>Do not accept:</b> more than one reference to scale; References to finishing (smoothing, sanding, etc); references to “hand saw”/“machine saw” (TV)</p>

Question	Expected Answers	Marks	Guidance
d	 <p>Drill axle holes larger than axle diameter (1)</p>  <p>Drill hole for axle away from centre (1)</p>  <p>Left-hand and right-hand sides to be arranged to allow rocking motion (1)</p> <p>Axes to be glued ONLY to wheels, free-running inside base (1)</p> <p>Each point worth one mark 1 x 4</p>	[4]	<p><b>Either notes OR sketches 3 marks max.</b></p> <p><b>Accept:</b> egg-shaped cam/wheel (could just be badly-drawn circular wheel!); modified wheel shape/size causing off-set movement.</p> <p><b>Do not accept:</b> additional materials or components (springs/levers/odd-shaped cams)</p>

Question			Expected Answers	Marks	Guidance
18	a	i	Transparent	[1]	
		ii	$3.5 \pm 1.5\text{mm}/2 - 5\text{mm}$ – <b>MUST state units</b>	[1]	<b>Accept:</b> 0.2 – 0.5cm/14-6 SWG/0.08-0.2in
	b		<p><b>USE HAND TOOLS</b></p> <p>Stick template to surface of acrylic/mark out shape and holes with permanent marker/marker pen (1)</p> <p>Clamping method, e.g small engineer's/bench vice and soft jaws OR bench peg (1)</p> <p>Sacrificial wood when drilling (1)</p> <p>Drill bit /hand-held power drill (1)</p> <p><b>Hand-held</b> fretsaw/piercing saw/jeweller's saw (1)</p> <p>File (1)</p> <p>Each relevant point worth one mark 1 x 4</p>	[4]	<p><b>Either notes OR sketches 3 marks max.</b></p> <p><b>Do not accept:</b> power tools (e.g. Hegner saw/vibrasaw/pillar drill); Abrafile/coping saw (too large)</p> <p>Illustration shows bench peg (1), template fixed to substrate (1), piercing saw (1) threaded through hole (1).</p> 

Question		Expected Answers	Marks	Guidance	
	c	<p>Bend shape in middle (1) ... using line bender (1)</p> <p>Use two shapes (1) ... to give 3D effect (1)</p> <p>Make shape in two or more pieces/layers (1) ... body/wings (1)</p> <p>Soften acrylic (1) .. and curve over former (1)</p> <p>Use laser cutter (1) ... to engrave surface of acrylic (1)</p> <p style="text-align: center;">One idea + method of achieving this</p>	[2]	 	<p>e.g.</p> <p><b>Do not accept:</b> use of paints or other colourants.</p>
	d	Polystyrene/PS/HIPS PVC	[1]	<p><b>Do not accept:</b> other alternatives</p>	

Question	Expected Answers	Marks	Guidance
18 e*	<p>This question is <b>not about the environmental issues</b> of laser cutting, but about the technical and/or commercial issues of cutting small, intricate shapes in batches.</p> <p>Answers ought to concentrate upon one or more of the following aspects.</p> <ul style="list-style-type: none"> <li>✓ Accurate</li> <li>✓ Repeatable</li> <li>✓ Fast</li> <li>✓ Costly to set up</li> <li>✓ Cutting does not have to start from an edge – more flexibility in laying designs onto sheet material</li> <li>✓ Width of cut (kerf) is less than 0.5mm – more shapes can be cut per sheet</li> <li>✓ Cutting is not limited to straight lines – more intricate shapes can be cut first time</li> <li>✓ Small pieces can be tessellated – reduces waste between pieces</li> <li>✓ Reduced skilled workforce</li> <li>✓ Cut edges are smooth - less finishing required</li> <li>✓ Workpiece does not need elaborate hold-down technology – less equipment needed</li> <li>✓ Workpiece and surroundings not contaminated by dust/chips – less extraction needed</li> <li>✓ Less warping of workpiece – less cooling needed</li> <li>✓ High power needed to cut thick metals – more energy needed</li> <li>✓ Low power needed to cut thin metals or woods/plastics – less cost of energy</li> </ul> <p>Answers may concentrate upon just one or two of the above aspects, or may jump from one to another. Best response will be broken down into 3 or 4 paragraphs, three majoring on one topic each, and one conclusion; not all topics need be covered.</p> <ol style="list-style-type: none"> <li>1. READ the full response and judge this in terms of the LEVEL of response (1, 2 or 3).</li> <li>2. THEN consider the quality of the “technical” content within that level to determine the final mark.</li> <li>3. IT IS POSSIBLE that the initial assessment of level will have to be modified if the candidate has written a good set of arguments relating to use of laser cutters generally (possible Level 3), but has not focused upon the topic in question (piercing and shaping small objects).</li> </ol>	[6]	<p><b>Level 3 (5-6 marks)</b> Sound discussion showing understanding of the techniques used when laser cutting <b>small objects</b>, including laying-out work and the economics of cutting and waste removal. Specific example relating to piercing and shaping small objects given and referred to. Specialist terms will be used appropriately and correctly. Answers clear and presented in a structured format. Accurate use of grammar, punctuation and spelling.</p> <p><b>Level 2 (3-4 marks)</b> Adequate discussion showing some understanding of the techniques used when laser cutting, including laying-out work and the economics of cutting and waste removal. Answers clear and presented in a mainly structured format. Occasional errors of grammar, punctuation and spelling.</p> <p><b>Level 1 (1-2 marks)</b> Basic discussion showing little understanding of the techniques used when laser cutting, including laying-out work and the economics of cutting and waste removal. Little or no use of specialist terms. Answers ambiguous and disorganised; intrusive errors of spelling, grammar and punctuation. Bullet points do not constitute a discussion, and can only be awarded Level 1 (max. 2 marks)</p> <p><b>0 marks</b> <b>Discussion wholly outside the topic</b>, not worthy of a mark.</p>

Question		Expected Answers	Marks	Guidance
19	a	<p>Steel rule(r)            Engineer's blue/marketing blue/layout blue/permanent marker            Scriber/scribe            Try square/engineer's square</p> <p>Any three relevant points 1 x 3</p>	[3]	<p><b>Do not accept:</b> woodworking tools (steel tape, marking knife, pencil, set square, felt-tip pen, etc.); methods of bending.</p>
	b	<p>Stops it rusting/corrosion prevention            Makes it look nice/cosmetic finish            Makes it match surroundings/environment</p> <p>Any two relevant points 1 x 2</p>	[2]	
	c	<p>Degrease/clean metal            Heat metal (to 180°) in oven            Dip hot metal in dry powdered, pigmented plastic            Powder to be "fluidised"/air passing through it            Reheat dipped metal to smooth surface coating            Leave to cool (only awarded if preceding process is correct)</p> <p>Any three relevant points 1 x 3</p>	[3]	<p><b>Do not accept:</b> dip in paint/leave to dry</p>
	d	<p>Thin rubber applied to it.            Thin rubber bonded to upstand            Thin rubber bonded to shelf of stand            Rubber/plastic tubing split and attached around edges            Edges to be folded</p> <p>One relevant point</p>	[1]	<p><b>Do not accept:</b> stick phone to ledge or upstand; non-slip pads under stand (different question!)</p>

Question		Expected Answers	Marks	Guidance
19	e	<p>Award a maximum of five marks SELECTED FROM THE FOLLOWING POINTS</p> <ul style="list-style-type: none"> <li>• <b>Adjustable</b> e.g. knuckle joint/friction joint/ratchet</li> <li>• <b>Will it fold?</b></li> <li>• <b>Lightweight</b>, either stated material choice e.g. aluminium, stainless steel tube OR structure e.g frame or minimum use of metal</li> <li>• <b>Size</b> stated</li> <li>• <b>No protection</b> e.g stainless steel/aluminium</li> <li>• <b>Non-scratch</b> underside e.g. soft buffers/pads/feet to prevent scratching</li> </ul> <p>Additionally, one mark may be awarded for</p> <ul style="list-style-type: none"> <li>• <b>Method(s) of construction</b> e.g all fixings to be appropriate machine screws, rivets or similar</li> </ul> <p>[1]</p>	[5]	<p><b>Either notes OR sketches 3 marks max.</b></p> <p><b>Accept:</b> Aluminium or s/steel should be rewarded twice (lightweight AND non-corrodible)</p> <p><b>Do not accept:</b> fixing butt hinges to flat metal sheet unless well qualified (nuts and bolts or rivets)</p> <p>[6]</p>  <p>Friction hinge (wing nut fixing?) Stainless steel rod Strong enough if annotated S/steel doesn't need painting Plastic coatings to rod</p> <p>[6]</p>  <p>Knuckle hinge Aluminium Definitely strong Aluminium anodised Plastic feet and hinge spacers</p> <p>[6]</p>

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