

## **GCSE**

# **Design and Technology: Electronics and Control Systems**

Unit **A515/03**: Sustainability and technical aspects of designing and making mechanisms

General Certificate of Secondary Education

## **Mark Scheme for June 2017**

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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

Annotation	Meaning
	Blank Page – this annotation must be used on all blank pages within an answer booklet (structured or unstructured) and on each page of an additional object where there is no candidate response.
	Level 1
	Level 2
	Level 3
	Noted but no credit given
	Tick

## SECTION A

Question		Answer	Mark	Guidance
1		A	1	
2		A	1	
3		B	1	
4		D	1	
5		A	1	
6		Reduction in the amount of waste materials	1	Allow other valid responses related to less environmental pollution.
7		Reduction in emissions of carbon dioxide or greenhouse gases made in order to compensate for an emission made elsewhere.	1	
8		<ul style="list-style-type: none"> <li>• Use less energy / power</li> <li>• Last longer.</li> <li>• Easier recycling process and less waste.</li> </ul>	1	
9		<ul style="list-style-type: none"> <li>• The colour red is often used in warning and hazard signs.</li> <li>• It symbolises danger.</li> <li>• It stands out against other colours.</li> <li>• It is a very visible colour in daylight.</li> </ul>	1	
10		Refuse	1	
11		True	1	
12		True	1	
13		False	1	
14		False	1	
15		False	1	

Question		Answer	Marks	Guidance
16	(a)	<p>Any of the following:</p> <ul style="list-style-type: none"> <li>• Spring loaded</li> <li>• Quick lock and release button - allow 'control button'</li> <li>• Comfortable (ergonomic) handle</li> <li>• Flexible lead</li> <li>• Clip is attached easily to dog's collar.</li> <li>• Durable / tough plastic case</li> </ul> <p style="text-align: right;">3 x 1 marks</p>	3	<p>Accept any other valid response.</p> <p>Do not allow 'extendable', 'portable' or 'ergonomic' with no link to a feature.</p>
	(b)	<ul style="list-style-type: none"> <li>• Batteries have limited life / need to be replaced</li> <li>• No harm to the environment</li> <li>• No batteries to dispose of</li> <li>• No additional expense e.g. battery disposal</li> </ul> <p style="text-align: right;">2 x 1 marks</p>	2	Accept any two answers or other valid response
	(c)	<p>Simple statement e.g.: its properties can change. (Does not state how the change is triggered) 1 mark.</p> <p>A material whereby its properties can be changed by external stimuli, such as stress, temperature, moisture, pH, electric or magnetic fields, 1 mark.</p>	2	
	(d)	<ul style="list-style-type: none"> <li>• Both features included in the redesign [2 x 1]</li> <li>• Specific materials identified [1]</li> <li>• Components identified [1]</li> <li>• Helpful annotation to explain thinking [1]</li> </ul>	5	

Question	Answer	Marks	Guidance
(e)	<ul style="list-style-type: none"><li>• Low cost to manufacture</li><li>• Easy to work / shape / form</li><li>• Can be recycled / made from recycled materials</li><li>• Biodegradable</li><li>• Print directly to surface / decorate</li><li>• Protect contents</li><li>• Durable / strong</li><li>• Lightweight and easy to transport</li></ul> <p style="text-align: right;">2 x 1 marks</p>	2	

Question			Answer	Marks	Guidance	
					Content	Levels of response
	(f)*		<p><u>Advantages</u></p> <ul style="list-style-type: none"> <li>• Improved living standards</li> <li>• Increase in public health benefits</li> <li>• Interconnected nations share best practice. Kyoto Protocol, for example.</li> <li>• Larger markets, create more jobs</li> <li>• Ease of internet purchase</li> </ul> <p><u>Disadvantages</u></p> <ul style="list-style-type: none"> <li>• Worldwide shortages of finite materials</li> <li>• Worker exploitation (ETI)</li> <li>• Increased energy consumption</li> <li>• impact on carbon footprint</li> <li>• transportation impact</li> <li>• toxic waste in relation to production &amp; manufacture</li> <li>• Changes to social and spiritual well being</li> <li>• Spread of human, animal and plant diseases</li> </ul>		Maximum of 2 marks for a bullet point list.	<p><b>Level 3 (5-6 marks)</b> Thorough explanation, with examples, showing a clear understanding of how globalisation affects the environment. There may be three or more clearly identified and explained points. Specialist terms will be used appropriately and correctly. The information will be presented in a structured format. The candidate will demonstrate the accurate use of spelling, punctuation and grammar.</p> <p><b>Level 2 (3-4 marks)</b> Adequate explanation, possibly with examples, showing a sound understanding of how globalisation affects the environment. There will be some use of specialist terms, although these may not always be used appropriately. The information will be presented for the most part in a structured format. There may be occasional errors in spelling, grammar and punctuation.</p> <p><b>Level 1 (1-2 marks)</b> Basic explanation, possibly without examples, showing some understanding of how globalisation affects the environment.. There will be little or no use of specialist terms. Answers may be ambiguous or disorganised or 'list like'. Errors of grammar, punctuation and spelling may be intrusive.</p>
				[6]		

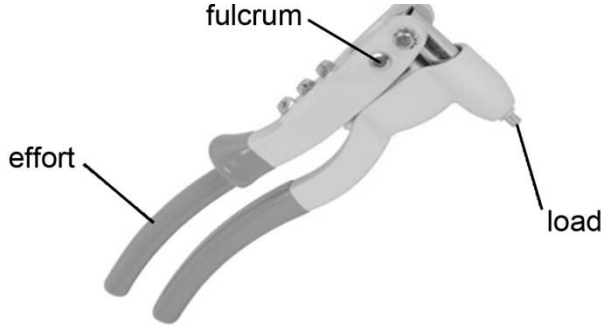
						(0) Response worthy of no marks.
			TOTAL	[35]		



## SECTION B

Question			Answer / Indicative Content	Mark	Guidance
17	(a)	(i)	Worm [1] and wormwheel [1]	2	Accept worm and worm gear, worm gear & spur gear, worm drive 1 mark.
17	(a)	(ii)	The speed of the beater shafts will be <b>reduced</b>	1	Do not accept 'change in speed', accept slower.
17	(a)	(iii)	Two arrows drawn to indicate that the beaters will move in <b>opposite</b> directions	1	
17	(a)	(iii)	Any <b>one</b> from: <ul style="list-style-type: none"> <li>• Increased torque</li> <li>• No slippage / one way movement</li> <li>• <b>Large</b> reduction in speed</li> <li>• Does not take up much space</li> </ul>	1	Do <b>not</b> allow 'change of speed' this is given in the question. Allow any other valid benefit
17	(b)	(i)	VR = 50/1 <b>or</b> 50:1	1	
17	(b)	(ii)	Speed of beaters = motor speed / VR = 2000 / 50 [1] = 40rpm [1]	2	Units not required.
17	(c)	(i)	Nylon	1	Allow ABS, polypropylene, acetyl, delrin, tufnol, pvc polythene.

Question			Answer / Indicative Content	Mark	Guidance
17	(c)	(ii)	<p>Two properties of stainless steel that make it suitable for the food bowl:</p> <ul style="list-style-type: none"> <li>• Hygienic</li> <li>• Will not corrode or rust</li> <li>• Does not give impart taste</li> <li>• Easily formed into bowl shape</li> <li>• Durable</li> </ul>	2	
17	(d)	(i)	<p>Strip heater Wire strip heater</p>	1	Not oven or hot air gun
17	(d)	(ii)	<p>1 mark for workable idea. 1 mark for jig/former showing 90 degrees.. 1 Evidence of repeatability</p>	3	Allow line bender

Question		Answer / Indicative Content	Mark	Guidance
18	(a)		3	1 mark for each correct label. Allow pivot for fulcrum, force for effort, or force for load. Not force, fulcrum, force.
18	(b) (i)	A <b>rise or fall / change</b> in temperature	1	Allow change in pressure or speed of movement. Change in light (sunrise or sunset/darkness).
18	(b) (ii)	<p><b>Shape memory alloys (SMA) / sometimes called Nitinol</b> Glasses frames. Medical and dentistry use.</p> <p><b>Muscle wire</b> Same properties as Nitinol. Can be used in robotic</p> <p><b>Polymorph</b></p>	2	<p>1 mark for name of a smart material (any). 1 mark for stating how it would be used in a mechanism.</p> <p>Do <b>not</b> accept smart grease (already given in the question)</p> <p>Must be suitable for a mechanism. Do <b>not</b> accept Thermo-chromic inks or phosphorescent paint.</p> <p><b>Allow: QTC cord or pills.</b></p> <p><b>Nanoparticles</b> - Improves mechanical properties of a material. Used in motor and aeronautical industry. Insulation and lighting systems.</p>

Question			Answer / Indicative Content	Mark	Guidance
18	(c)	(i)	Rack and pinion	1	
18	(c)	(ii)	1 mark for rack being vertical and in line with bracket. 1 mark for the pinion being located in greenhouse in order for window to shut. 1 mark for <b>workable</b> idea, 3 x 1 marks.	3	Rack must be connected to window(lid) bracket. Must be a realistic solution, not just a R&P drawn
18	(c)	(iii)	Additional material added to rack to allow moveable pivot to be designed.  1 mark for workable idea. 1 mark for clarity of sketch and articulation of idea	2	Accept either the graphical or physical representation of a rack and pinion
18	(c)	(iv)	To allow the arc movement of the window as it pivots on the hinge.  To maintain the vertical movement of the rack.  Installation, functionality and maintenance.	1	
18	(c)	(v)	E.g. <ul style="list-style-type: none"> <li>• Grub screw</li> <li>• Cotter pin</li> <li>• Split pin</li> <li>• Splined shaft</li> </ul>	2	Allow both the handle (labelled) and the whole assembly secured to the shaft.

Question			Answer / Indicative Content	Mark	Guidance
			<ul style="list-style-type: none"> <li>Any type of key. E.g. tapered / feathered / wodruff</li> <li>Welded / loctite</li> </ul> <p>1 mark for quality of sketch. 1 mark for naming <b>or</b> articulating method of securing handle and shaft together.</p>		
19	(a)	(i)	<p><b>A</b> Snail or Drop cam</p> <p><b>B</b> Pear shaped cam</p> <p><b>C</b> Eccentric cam</p> <p>3 x 1 marks.</p>	3	<p>Allow drop-off or either name for cam <b>A</b></p> <p>Allow egg-shaped cam for <b>B</b></p> <p>Allow circular/off centre cam for <b>C</b></p>
19	(a)	(ii)	Tick in the box for cam <b>C</b> Eccentric cam	1	Do not allow Cam B – pear shaped cam. There is a 'dwell' period during each revolution therefore does not allow a <b>smooth</b> rise and fall
19	(b)	(i)	Stepped pulley block <b>B</b> – directly attached to motor	1	
19	(b)	(ii)	<p>Any two reasons e.g.</p> <ul style="list-style-type: none"> <li>To be able to drill at different speeds</li> <li>To allow different speeds depending on the size of drill being used</li> </ul>	2	

Question			Answer / Indicative Content	Mark	Guidance
			<ul style="list-style-type: none"> <li>To allow different speeds depending on the type of material being drilled through</li> <li>Safety reasons. Being able to drill at low speeds to test clamping of material is secure.</li> </ul>		
19	(c)		<p>Any two reasons e.g.</p> <ul style="list-style-type: none"> <li>Sprocket and chain provide a positive drive</li> <li>To prevent 'slippage', which occurs with a pulley and belt system under load</li> <li>Sprocket and chain system can be combined to provide a high number of gear ratios</li> <li>Heat build up may occur with a pulley and belt system</li> <li>Sprocket and chain drives provide more torque</li> <li>Sprocket and chain drives can operate in the wet</li> <li>Sprocket and chain systems are more compact</li> </ul>	2	

Question		Answer	Marks	Levels of response
19	(d)*	<p><b>Advantages</b> Using modular components could have advantages such as:</p> <ul style="list-style-type: none"> <li>• Use of standard parts and assemblies</li> <li>• Quicker design process</li> <li>• Ease of assembly and transportation to and on site</li> <li>• Ease of maintenance (replace broken/worn part)</li> </ul> <p>Cost can be broken down into many aspects –</p> <ul style="list-style-type: none"> <li>• Cost of labour</li> <li>• Cost of machinery</li> <li>• Floor space</li> <li>• Energy</li> <li>• Storage</li> </ul> <p>All these add up to increased costs in production. If sub parts can be bought in from companies that produce these parts in large batch / mass production at lower unit cost there is an advantage to the manufacturer. Examples of sub parts range from purchasing nuts and bolts to a complete gearbox.</p> <p><b>Disadvantages</b></p> <ul style="list-style-type: none"> <li>• Requires system integration</li> <li>• Parts need fitting together correctly and accurately</li> <li>• Needs some assembly work e.g. cost Being reliant on other companies</li> <li>• Delivery times</li> <li>• Quality of product</li> <li>• Fluctuating prices</li> <li>• If supplier goes out of business</li> </ul>	6	<p><b>Level 3 (5-6 marks)</b> Shows detailed understanding of why manufacturers use modular components in the design and production of mechanical systems. Suitable examples used. Specialist terms will be used appropriately and correctly. The information will be presented in a structured format. The candidate can demonstrate the accurate use of spelling, punctuation and grammar.</p> <p><b>Level 2 (3-4 marks)</b> Shows some understanding of why manufacturers use modular components in the design and production of mechanical systems. There will be some use of specialist terms although these may not always be used appropriately. The information will be presented for the most part in a structured format. There may be occasional errors in spelling, punctuation and grammar.</p> <p><b>Level 1 (1-2marks)</b> Shows limited understanding of why manufacturers use modular components in the design and production of mechanical systems. No examples used. There will be little or no use of specialist terms. Answers may be ambiguous or disorganised. Errors of grammar, punctuation and spelling may be intrusive.</p> <p><b>0</b> Response worthy of no marks.</p>

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