

## **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 2014**

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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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Question		Answer	Marks	Guidance
1		C	1	
2		A	1	
3		B	1	
4		B	1	
5		A	1	
6		Refuse	1	Only
7		Any of: SMA (Nitinol), Polymorph, thermo-chromic dye, QTC.	1	Not acrylic.
8		May contain Toxic/hazardous chemicals or lead / mercury / cadmium / copper (heavy metals).	1	Reference to toxic, any known e-waste or explained source of 'fumes'. Not 'harmful'.
9		Reference to tables of anthropometric data. Direct measuring/researching the human body or parts of the human body, references to measuring.	1	Not 'survey' or 'questionnaire'
10		Life Cycle Analysis	1	
11		False	1	
12		False	1	
13		True	1	
14		False	1	
15		True	1	
16	(a)	Any of: <ul style="list-style-type: none"> <li>• LCD display / 7 segment display / digital timer</li> <li>• Dual timing dials</li> <li>• Hinged lid/plastic cover</li> <li>• Control buttons</li> <li>• Connections for hoses / two outlets</li> <li>• A clock / display</li> <li>• Day/night options</li> <li>• Easy to grip dials / rounded corners</li> <li>• Large text for increased visibility</li> <li>• Easy to understand controls</li> </ul>	3	Allow direct reference to control of flow RATE.
	(b)	Any of: <ul style="list-style-type: none"> <li>• Solar power</li> <li>• Use rechargeable cells</li> <li>• Fit super-capacitor</li> </ul>	2	Allow wind power, although unlikely! Do not allow H.E.P. Not mains electricity unless qualified as 'green-sourced'. MUST refer to power, not aesthetics or ergonomics.

Question		Answer	Marks	Guidance
		<ul style="list-style-type: none"> <li>Optimise circuitry for minimum current drain</li> <li>Use latching (magnetic) solenoids</li> </ul>		
(c)	(i)	Re-cycling, tertiary recycling, correct bin at tip, bin in supermarket, return to vendor.	1	Allow legitimate alternatives.
	(d)	Any of: <ul style="list-style-type: none"> <li>So customer can see what the product looks like</li> <li>Water/shower and dust proof so good 'as new' even after being on display for months</li> <li>Can't be tampered with/have parts lost or stolen</li> <li>Fast packaging of items for manufacture</li> <li>Strong and durable compared to cardboard alternatives</li> <li>Complex shape</li> </ul>	2	Nothing cost related. Stronger, durable should be qualified. Not 'as it can be recycled'.
	(e)	Any combination of: <ul style="list-style-type: none"> <li>Uses fossil fuel / oil / coal derived product for manufacture</li> <li>Increased greenhouse gas emissions / global warming contribution</li> <li>Does not degrade in the environment</li> <li>Needs sorting before recycling</li> <li>May emit fumes/poisonous gases if burnt</li> <li>May harm wildlife</li> <li>May spoil habitats</li> </ul>	3	Reasoned response including 3 reasons for full marks. Allow full marks for 1 or 2 points which have been well explained.
	(f)	Sketches and notes to show useful information such as: Recycling code for plastic(s) used Water based non-toxic ink FSC approved wood-pulp source Recycle logo / mobius loop Kitemark, CE, BS, Disposal, WEEE, Type of batteries	3	Appropriate information relating to the function, care, operation and disposal of the item.

Question		Answer	Marks	Guidance	
				Content	Levels of response
	(g)	<p>Candidates should identify examples Where electronics can save energy such as CFLs, LED lighting, occupancy / movement monitors, in fact any reasonable sensing of a parameter be it light, heat or moisture and then acting on that parameter using electronics. Water saving can be simple statements like only fill the kettle with what you need to boil, so saving energy and water, through to a logical expansion of the unit pictured in Fig.1 which combines both to control water usage.</p>	6	<p>Maximum of 2 marks for short bullet. General comments such as 'shower instead of bath' can be credited. For full marks answers should refer to how electronics can contribute to saving water <b>and</b> energy.</p>	<p><b>Level 3 (5-6 marks)</b> Thorough explanation, showing a clear understanding of how electronics can influence and control our energy and water consumption. There will 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, showing an understanding of how electronics can influence and control our energy and water consumption. 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, showing some understanding of how electronics can influence and control our energy and water consumption.</p>

Question		Answer	Marks	Guidance	
				Content	Levels of response
					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. <b>(0) response worthy of no marks</b>
			<b>Question 16 total</b>	<b>20</b>	
			<b>Section A Total</b>	<b>35</b>	
			<b>Section B</b>		
<b>17</b>	<b>(a)</b>	Simple sketches on the axle (or drawn as exploded) with either cams, crank(s) or gears/pulleys that contrive to produce some form of movement, ideally two different but see guidance.		<b>4</b>	Duplicate designs that show nothing new on the second design score 2, unless qualified why, e.g. penguin needs to move from side to side as it walks, so two similar cams in anti-phase with reference to why could score 4
	<b>(b) (i)</b>	Parts fit together and locate themselves (self-jigging) without the need for external clamps, jigs, tools etc.		<b>2</b>	'Description and Benefit', 'How and why' for 2 marks Description alone, 1 mark. Not 'for easy or repair' or related.
	<b>(ii)</b>	PVA, Poly Vinyl Acetate.		<b>1</b>	Only, but allow cow or hide glue.
	<b>(iii)</b>	Epoxy resin or trade named equivalent, araldite, 5-minute epoxy etc.		<b>1</b>	Accept Gorilla glue, superglue (cyanoacrylate), but do not accept PVA or glue gun.
	<b>(c)</b>	Cam A, eccentric (egg-shaped) steady rise and fall (over 1 rotation) Cam B Snail cam, slow rise sudden fall		<b>4</b>	1 for name, 1 for explanation (x2) Not 'drop cam'. Name does not have to be correct to score description mark.

Question		Answer	Marks	Guidance	
	(d)	<p>CAD makes it simple to draw the design once the software basics have been learnt. It also allows:</p> <ul style="list-style-type: none"> <li>• Ability to edit aspects of the drawing</li> <li>• Small file can easily be emailed to and from school/home</li> <li>• Common template which pupils could modify as required</li> <li>• High quality output on paper/screen</li> </ul> <p>CAM means that the making will be very accurate as per the drawing, mistakes and all.</p> <ul style="list-style-type: none"> <li>• Precise cutting</li> <li>• Repeatability</li> <li>• Speed</li> <li>• Layout optimisation</li> </ul>	3	Marks can be derived from either CAD, CAM or both.	
		<b>Question 17 total</b>	<b>15</b>		
18	(a)	(i)	Crankshaft or crank	1	Only
		(ii)	Reciprocating motion, 4 <sup>th</sup> box along.	1	Only
		(iii)	Nut and tie-rod / threaded bar	2	Not Bolt. Nut only 1 mark.
	(b)	(i)	Grease cups to hold a supply of clean grease	1	Or similar description such as 'grease gun not needed daily'.
		(ii)	To enable the viscous grease to be forced into the bearing under pressure as required.	2	Or similar description of same basic principle.
		(iii)	<p>A sentence or bullet points/list that embodies two of the following:</p> <ul style="list-style-type: none"> <li>• A mixture of two or more elements</li> <li>• Of which iron is one element or:</li> <li>• Must contain iron</li> <li>• To modify the working properties of iron</li> <li>• By the addition of other elements</li> </ul>	2	<p>Appropriate reference to iron required....NOT Steel. 1 mark for description of alloy 1 mark for relating one of the metals to iron</p>

Question		Answer	Marks	Guidance	
				Content	Levels of response
	(c)*	<p>Candidates should discuss the benefits of being able to use materials (traditional or modern such as composites) and the advantages and disadvantages of using standard components. Better answers will employ examples to illustrate their points, such as a mainstream car manufacturer vs. a F1 car manufacturer.</p> <p>Any appropriate machine can be used.</p>	6	Maximum of 2 marks for short bullet point list	<p><b>Level 3 (5-6 marks)</b> Thorough explanation, showing a good knowledge of materials and components and their applications. There will 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, showing some knowledge of materials and components and their applications.. 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, showing a limited knowledge of materials and components and their applications. There will be little or no use of specialist terms. Answers may be ambiguous or</p>



Question			Answer	Marks	Guidance	
					Content	Levels of response
						disorganised or 'list like'. Errors of grammar, punctuation and spelling may be intrusive. <b>(0) response worthy of no marks</b>

			Question 18 total	15	
<b>19</b>	<b>(a)</b>		Left to right on Fig. 7 Effort (E) Fulcrum (F) Load (L).	<b>3</b>	
	<b>(b)</b>		<b><math>100 \cdot 0.5 = 75 \cdot X</math></b> . $x=50/75$ or $2/3$ or $0.66$ or $0.67$ <b><math>100 \cdot 0.5/75 = X</math></b>	<b>2</b>	2 marks for correct numerical answer. If correct arrangement of numbers shown (in bold to left with wrong answer) 1 mark
	<b>(c)</b>		Any of: <ul style="list-style-type: none"> <li>• Harder (than mild steel)</li> <li>• Can be hardened</li> <li>• Harder (so wears better/lasts longer)</li> <li>• Will keep a sharp point</li> </ul>	<b>2</b>	Check for repeats under different wording. Two distinct reasons or 'reason' and 'why' for full marks. Allow 'strong' for 1 mark.
	<b>(d)</b>		To keep the spring under tension and so the hold down pin it is attached to under similar tension.	<b>2</b>	Reason why needed for 2 marks. Attachment/location 1 mark.
	<b>(e)</b>		Oil, light grease, silicon grease, 3-in-1 oil, WD40, GT85	<b>1</b>	Or other trade-named spray grease/lubricant
	<b>(f)</b>	<b>(i)</b>	Simple sketch showing either a plain bush or a shouldered bush that fits in the gap shown but around the pin.	<b>2</b>	Simple square/rectangular bush for 1 mark, 'Top-Had/Shoulder on bush for 2 marks or appropriate annotation if it helps the explanation of fixing (grub screw/Loctite) Any bush drawn as continuous (i.e. non-sectioned) 1 mark.
		<b>(ii)</b>	Any of: <ul style="list-style-type: none"> <li>• Brass</li> <li>• Bronze</li> <li>• Nylon</li> <li>• PTFE</li> <li>• Sintered (Bronze) bush</li> </ul>	<b>2</b>	1 mark per material

Question		Answer	Marks	Guidance
	(g)	Paint/lacquer/oil/blackened(with oil), blued, BZP, Nickel or chrome plated, galvanising.	1	
		<b>Question 19 total</b>	<b>15</b>	
		<b>Paper Total</b>	<b>80</b>	

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