

## **GCSE**

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

Unit **A515/02**: Sustainability and technical aspects of designing and making pneumatics

General Certificate of Secondary Education

## **Mark Scheme for June 2014**

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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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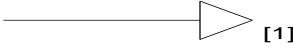

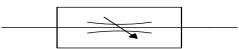
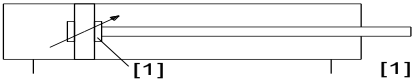
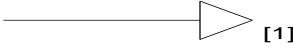

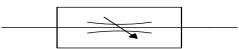
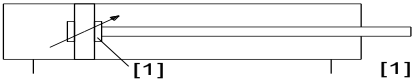
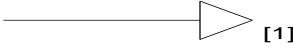

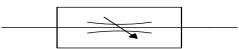
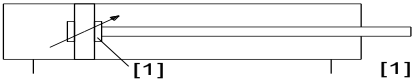
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Question		Answer	Mark	Guidance
1		C	1	
2		A	1	
3		B	1	
4		B	1	
5		A	1	
6		Refuse	1	Only
7		Any of: SMA_(Nitinol) Polymorph, thermo-chromic dye QTC	1	Not acrylic
8		May contain Toxic/hazardous chemicals or lead / mercury / cadmium / copper (heavy metals)	1	Reference to toxic/harmful, 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,	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 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> <li>• Optimise circuitry for minimum current drain</li> </ul>	2	Allow wind power, although unlikely! Do not allow Hydro Electric Power Not mains electricity unless qualified as a green sourced Must refer to power, not aesthetics or ergonomics

Question	Answer	Mark	Guidance
	<ul style="list-style-type: none"> <li>• Use latching (magnetic) solenoids</li> </ul>		
(c)	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> </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 marks for 1 or 2 points well explained.
(f)	Sketches and notes to show useful information such as: <ul style="list-style-type: none"> <li>• Recycling code for plastic(s) used</li> <li>• Water based non-toxic ink</li> <li>• FSC approved wood-pulp source</li> <li>• Recycle logo / mobius loop</li> <li>• Kitemark / CE, BS, Disposal, WEEE</li> <li>• Type of batteries</li> </ul>	3	Appropriate information relating to the function, care, operation and disposal of the item.

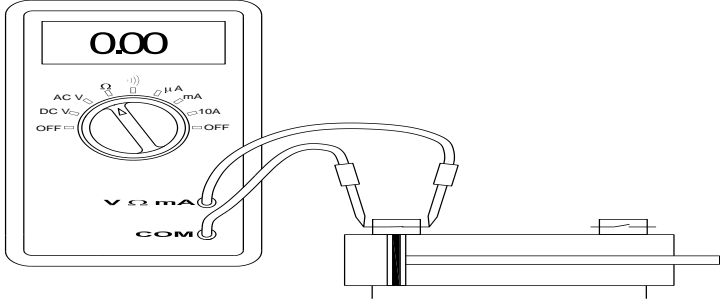
Question		Answer	Marks	Guidance	
				Content	Levels of response
	(g)	<p>Candidates should identify examples where electronics can save energy such as CFLs, LED lighting, occupancy / movement monitors, in fact any reasonable sensing of a parameter be it light, heat or moisture and then acting on that parameter using electronics.</p> <p>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 point list</p> <p>General comments such as shower instead of bath can be credited.</p> <p>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
						<p>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></p>
			<b>Question 16 total</b>	<b>20</b>		

Question	Answer	Mark	Guidance										
<p>17 (a)</p>	<table border="1"> <thead> <tr> <th>component name</th> <th>component symbol</th> </tr> </thead> <tbody> <tr> <td> <p><b>A</b> exhaust</p> </td> <td>  [1]                 </td> </tr> <tr> <td> <p><b>B</b> air line T junction [1]</p> </td> <td>  </td> </tr> <tr> <td> <p><b>C</b> bi-directional [1] restrictor or regulator [1]</p> </td> <td>  </td> </tr> <tr> <td> <p><b>D</b> double acting cylinder with adjustable cushioning</p> </td> <td>  </td> </tr> </tbody> </table>	component name	component symbol	<p><b>A</b> exhaust</p>	 [1]	<p><b>B</b> air line T junction [1]</p>		<p><b>C</b> bi-directional [1] restrictor or regulator [1]</p>		<p><b>D</b> double acting cylinder with adjustable cushioning</p>		<p>[1] [1] [2] [2]</p>	
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<p>(b)</p>	<p>(i) Filter: removes water that is present in compressed air. (ii) Regulator: allows pressure to be set at a reduced level to the pressure in the air receiver.</p>	<p>[1] [1]</p>											
<p>(c)</p>	<p>(iii) Gauge: displays the set pressure</p> <p>The combined filter regulator and gauge should be fitted at the point just after the compressor and <b>before the start of the circuit</b> [1]. This removes water before it can get to the pneumatic components [1] and the pressure is set at the start of the circuit [1]. Circuit pressure can be read at this point. [1]</p> <p>Areas for inspection could include:</p> <ul style="list-style-type: none"> <li>• Electrical safety of compressor motor</li> <li>• Pressure relief valve operation</li> <li>• External damage to receiver tank</li> </ul>	<p>[1] [1] [3] [3]</p>	<p>Allow marks for understanding shown. E.g. reference to removal of unwanted materials</p> <p>Any three points included in the explanation for 3 marks. Allow other valid areas for inspection. Do not allow filter, regulator, or gauge.</p>										

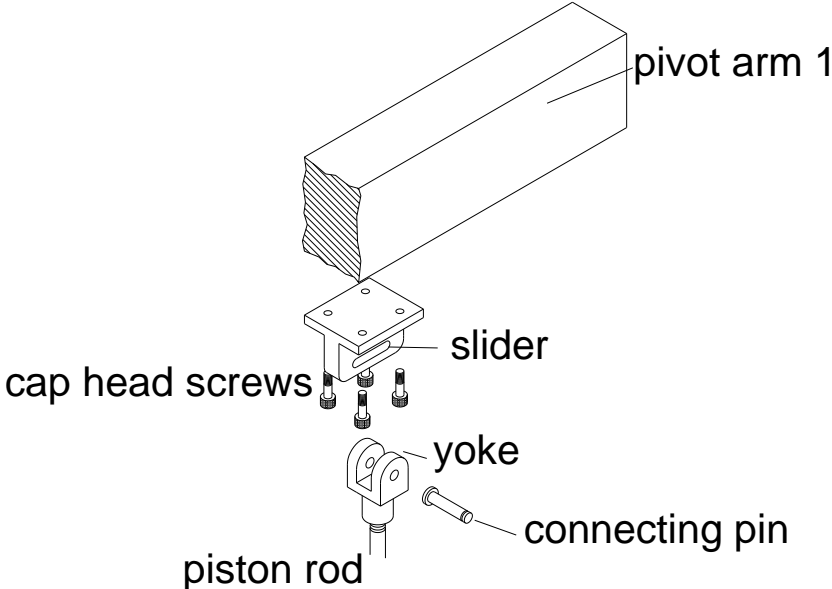
	(d)			
Question		Answer	Mark	Guidance
		<ul style="list-style-type: none"><li>• Internal inspection of receiver tank and welds</li><li>• Check support and mounting brackets</li><li>• Operation of manual drain valve</li></ul> Any three areas, 3 x 1 marks		
			<b>TOTAL</b>	<b>[15]</b>



Question		Answer	Mark	Guidance
18	(a) (i)	Uni-directional flow control valve	[1]	Allow restrictor or flow control valve, no mark for bi-directional.
	(ii)	The air to the cylinder is unrestricted [1] the exhaust port is restricted, allowing control of the piston speed. [1]	[2]	Allow marks for understanding shown of the operation of the restrictor.
	(b) (i)	To check that the reed switches closes when the magnetic piston is next to the reed switch a meter set to resistance to check the continuity [1] when the piston rod is next to the reed switch [1] it should show very low resistance [1]. 	[3]	Allow marks for written description, clear drawing or combination. No marks for visual check on contacts. Allow other suitable test, e.g. bulb, LED or buzzer to check for continuity. Allow 1 mark for moving piston to activate reed switches.
	(ii)	The output signal from PLC [1] is connected to a solenoid operated valve, [1]	[2]	
	(c) (i)	Specification points must relate to the stop button, e.g. <ul style="list-style-type: none"> <li>The emergency button must be within easy reach to all ages.</li> <li>The emergency button should be capable of being operated single handed using either hand.</li> <li>The emergency button must be sighted in a clearly visible position.</li> <li>The emergency button must be <b>big enough to hit</b>.</li> <li>The emergency button should not be in a position where it can accidentally be pressed.</li> </ul> 1 mark for each valid point, 3 x 1 marks	[3]	Allow - <u>Override all other controls</u>
	(ii)	The shuttle valve allows the two push button valves to act as an OR gate [1] When either stop button is pressed main air is directed through the shuttle valve to signal the circuit to stop [1]. At the same time the ball valve prevents main air escaping through exhaust of the other switch [1].	[3]	

Question		Answer	Mark	Guidance
	(iii)	Benefits of electronic switching could include: Electronic switch would be smaller [1] would allow a signal to go direct to PLC [1] Less force needed to operate the switch [1] No time loss with electronics switch, pneumatic valve involves mechanical movement, which takes longer [1]	[1]	Allow other valid benefits
			<b>TOTAL</b>	<b>[15]</b>

Question		Answer	Mark	Guidance
19	(a)	<p>Explanation should refer to the sequence A+ / B+ / B- / A- and the fact that <u>B- cannot work because there is still a signal holding B+(dual signal)</u>. It is not a repeat pattern, i.e. A+ / B+ / A- / B-. <del>(dual signal)</del> [1]</p> <p>This non repeat sequence will lead to opposing signals [1] that will prevent correct operation [1] Group system isolates components and prevents opposing signals [1]. 2 marks for explanation that includes any two points. Or detailed explanation of a single point.</p>	[2]	
	(b)	$F = P \times A$ $2000 = 2.5 \times A$ $A = \frac{2000}{2.5} \quad [1]$ $\text{Radius} = \sqrt{\frac{2000}{\pi \times 2.5}} \quad [1] = 15.95 \text{ mm} \quad \text{Diameter} = 31.91 \text{ mm} \quad [1]$	[3]	

Question	Answer	Mark	Guidance
(c)	<p>Attachment to threaded piston rod [1] Attachment to pivot arm 1 [1] Horizontal movement allowed [1] Functional design [1]</p>  <p>Diagram illustrating a mechanical linkage assembly. The components shown are:</p> <ul style="list-style-type: none"><li>pivot arm 1</li><li>slider</li><li>cap head screws</li><li>yoke</li><li>connecting pin</li><li>piston rod</li></ul>	[4]	One example shown, a range of methods could be used.

Question		Answer	Marks	Guidance	
				Content	Levels of response
	(d)*	<p>Feedback mechanisms should be an important part of the response.</p> <p><b>Automatic feedback</b> – via components in the system</p> <p><b>Manual feedback</b> – via valve operation</p> <p><b>Position of components</b> e.g. pistons instroked or outstroked.</p> <p>Piston hitting roller operated valve</p> <p>Use of reed switches / microswitches</p> <p>Electrical switches used for positioning</p> <p><b>Presence or absence of objects</b></p> <p>Information on the position of a machine operator,</p> <p>Use of AND gate on start controls to ensure hands are clear.</p> <p>Air bleed occlusion circuits / use of changing air pressure to give indication</p> <p><b>Timing components</b></p> <p>Use of air reservoir to cause delay</p> <p>PLC or computer control using electronic sensing devices</p> <p>Examples of feedback methods should be included for level 3.</p>	[6]	<p>Allow 1 mark for examples of verbal or written feedback to designer or manufacturer.</p>	<p><b>Level 3 (5-6 marks)</b></p> <p>Shows detailed understanding of the methods of providing feedback and reasons for it being needed in a circuit. 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></p> <p>Shows some understanding of the use of feedback in pneumatic circuits. There will be some use of specialist terms although theses 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 (1-2 marks)</b></p> <p>Shows limited understanding of the principles or reasons for feedback in a circuit. 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></p> <p>Response worthy of no marks.</p>
		<b>TOTAL</b>	<b>[15]</b>		

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