

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 2016

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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.


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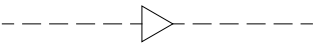

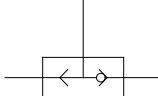
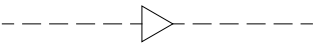

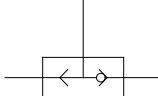
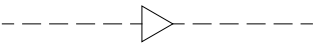

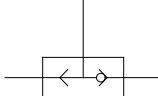
Question		Answer	Mark	Guidance
1		C	1	
2		B	1	
3		D	1	
4		A	1	
5		C	1	
6		SMA, smart metal, memory metal, memory alloy, muscle wire, smart alloy, nitinol, smart wire	1	
7		Any of: <ul style="list-style-type: none"> • Poison • Toxic to humans • Harmful • Reduces brain development 	1	Allow other legitimate hazards Do not allow 'can be dangerous'.
8		Reduction in transport costs brought about by not having to 'go to the meeting' by sundry transport methods.	1	
9		Crowded/dangerous/difficult overheated working environment often for minimum wage, child labour and no rights, unregulated working.	1	
10		Acrylic (pmma, perspex, plexiglass,) polystyrene, ABS, polyester.	1	Or other oil based polymers not common in schools such as polyethylene, polypropylene, PVC. Exclude natural plastics such as casein or horn. Do not allow 'polymer' or 'thermoplastics'.
11		False	1	
12		False	1	
13		False	1	
14		True	1	
15		True	1	
16	(a)	Any of: <ul style="list-style-type: none"> • Slot for player to be held in • Lead to connect to audio source/ipod/mp3 • USB power lead • Can be charged • Two removable speakers 	3	Allow any other valid response

Question		Answer	Mark	Guidance
		<ul style="list-style-type: none"> • Volume control • On/off switch • Some sort of stand/base/prop device • Can be folded • Speakers protected in transit • Aesthetics 		
	(b)	Any of: <ul style="list-style-type: none"> • Batteries not needed • No disposal issues of spent batteries • Can power and charge should it have rechargeable cells fitted • Increasing availability of standardised USB style chargers (PSU) • Means it can be used in any country • Could accept power from other sources e.g. host computer, solar or 'emergency/duration extender' power packs 	2	Allow reduced cost from no batteries

Question	Answer	Mark	Guidance														
(c)	<p>Parts identified as per question</p> <table border="1" data-bbox="342 244 1106 662"> <thead> <tr> <th data-bbox="342 244 819 282">Name of Part</th> <th data-bbox="819 244 1106 282">Letter on Fig.2</th> </tr> </thead> <tbody> <tr> <td data-bbox="342 282 819 352">Integrated Circuit (IC) audio amplifier</td> <td data-bbox="819 282 1106 352">A</td> </tr> <tr> <td data-bbox="342 352 819 391">Loudspeaker from PC monitor</td> <td data-bbox="819 352 1106 391">C</td> </tr> <tr> <td data-bbox="342 391 819 461">MP3 player earphone lead with broken earphones</td> <td data-bbox="819 391 1106 461">E</td> </tr> <tr> <td data-bbox="342 461 819 531">Piece of hardboard salvaged from back of a cupboard</td> <td data-bbox="819 461 1106 531">F</td> </tr> <tr> <td data-bbox="342 531 819 601">Speaker grill from broken PC monitor</td> <td data-bbox="819 531 1106 601">D</td> </tr> <tr> <td data-bbox="342 601 819 662">Tropical hardwood from old school bench</td> <td data-bbox="819 601 1106 662">B</td> </tr> </tbody> </table>	Name of Part	Letter on Fig.2	Integrated Circuit (IC) audio amplifier	A	Loudspeaker from PC monitor	C	MP3 player earphone lead with broken earphones	E	Piece of hardboard salvaged from back of a cupboard	F	Speaker grill from broken PC monitor	D	Tropical hardwood from old school bench	B	5	The first one is given in the question (Letter A).
Name of Part	Letter on Fig.2																
Integrated Circuit (IC) audio amplifier	A																
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Piece of hardboard salvaged from back of a cupboard	F																
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(d)	<p>Essentially expecting something like the picture but presented in a variety of ways such as multiple 2-D views, exploded view(s), rendered 3-D view(s) or combinations.</p> <ul style="list-style-type: none"> • Use of parts from Fig. 2, 1 mark • Drawings that communicate intentions clearly, 1 mark • Annotation, 1 mark • Functional design, 1 mark 	4	<p>Example of possible design</p> 														

Question		Answer	Marks	Guidance	
				Content	Levels of response
	(e)*	<p>Candidates should use examples when illustrating their points. Answers should relate to these examples rather than generic text explaining how the carbon footprint might be reduced by 'turning lights and machines off'. Suggestions such as</p> <ul style="list-style-type: none"> • Re-using LEDs • Chips • Screws and fixings • Wiring <p>With explanation about the reduction in energy used in preparing the parts for manufacture and actual manufacture, transport implications.</p> <p>3</p>	6	Maximum of 2 marks for short bullet point list	<p>Level 3 (5-6 marks) Thorough explanation, with examples, showing a clear understanding of how secondary recycling can contribute to a reduced carbon footprint. 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>Level 2 (3-4 marks) Adequate explanation, possibly with examples, showing a sound understanding of how secondary recycling can contribute to a reduced carbon footprint. 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>Level 1 (1-2 marks) Basic explanation, possibly without examples, showing some understanding of how secondary recycling can contribute to a</p>

Question			Answer	Marks	Guidance	
					Content	Levels of response
						reduced carbon footprint. 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. (0) response worthy of no marks
			Question 16 total	20		
			Section A Total	35		

Question		Answer	Mark	Guidance								
17	(a)	<table border="1"> <thead> <tr> <th>Component name</th> <th>Component symbol</th> </tr> </thead> <tbody> <tr> <td>A signal line</td> <td></td> </tr> <tr> <td>B reservoir</td> <td></td> </tr> <tr> <td>C shuttle valve</td> <td></td> </tr> </tbody> </table>	Component name	Component symbol	A signal line		B reservoir		C shuttle valve		<p>1</p> <p>1</p> <p>2</p>	<p>Allow reference to low pressure air or pilot air</p> <p>Allow only one connection to reservoir</p> <p>Outline of shuttle valve 1 Valve detail 1 Allow single acting cylinder or SAC</p>
Component name	Component symbol											
A signal line												
B reservoir												
C shuttle valve												

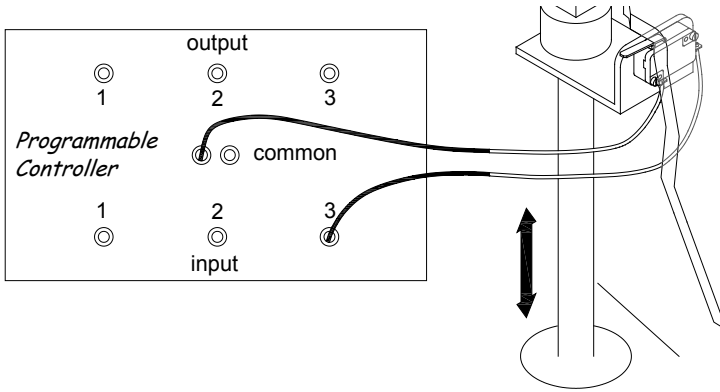
Question		Answer	Mark	Guidance
	(b) (i)	Single acting spring return cylinder, 1 mark.	1	
	(ii)	Reasons for ball end could be: <ul style="list-style-type: none"> • As a safety precaution to prevent injury from the end of the piston rod • To provide a bigger area to strike a target. 	1	
	(iii)	The ball end is unsuitable because it is not permanently attached to the item that it is pushing against so will not allow cylinder A to pull cylinder B back along the track when the piston of cylinder A instrokes. A bracket is needed on cylinder C piston rod to attach the target.	2	Allow 2 marks for a clear explanation of a single point
	(c)	Tools for assembly of the circuit will be: <ul style="list-style-type: none"> • Spanner • Screwdriver • Hexagon / allen key • Cutter for the connecting pipe. 2 x 1 marks for any two named tools.	2	Any two tools named for 2 marks. Do not allow wrench
	(d)	Checks before turning on system could be: <ul style="list-style-type: none"> • Check that all pipework is secure • Check that the pressure gauge show the correct pressure • Check that all components are secured • Know the position of emergency stop / air shut off valve • Check that all cylinder have room to outstroke. 3 x 1 marks	3	Allow other valid checks
	(e) (i)	The by-product produced is water , 1 mark	1	Allow moisture.
	(ii)	The water will cause corrosion in the components and receiver.	1	
TOTAL			15	

Question	Answer	Mark	Guidance
<p>18 (a) (i)</p>	<p>The diagram shows a pneumatic circuit. On the left, there are three 3/2-way valves labeled valve A, valve B, and valve C. Each valve has a spring return to the bottom position. Valve A is connected to cylinder A. Valve B is connected to cylinder B. Valve C is connected to a unidirectional flow restrictor, which is connected to a reservoir. Valve D is a diaphragm valve connected to the reservoir and cylinder C. Marking points [1] are indicated at valve A, valve B, valve C, and the restrictor/reservoir connection.</p>	<p>3</p>	<p>1 mark for valves A and B connected correctly. 1 mark for valve C to restrictor and reservoir. 1 mark for valve D to cylinder C.</p>
<p>(ii)</p>	<p>Air from valve C is fed into the unidirectional flow restrictor, 1 this can be adjusted for the length of time that it takes the reservoir to reach the operating pressure of the circuit. 1 Valve D is a diaphragm valve that is operated once the reservoir has reached working pressure. Main air from valve D will then operate cylinder C. 1</p>	<p>3</p>	<p>Allow marks for understanding shown in any part of the process.</p>

Question		Answer			Mark	Guidance
	(b)		position 1	position 2	position 3	1 mark for each correct valve position
	valve A	not pressed	pressed (not pressed)	pressed	3	
	valve B	not pressed	not pressed (pressed)	pressed		

Question		Answer	Marks	Guidance	
				Content	Levels of response
	(c)*	<p>Factors for consideration should include:</p> <ul style="list-style-type: none"> • Power needed to operate components • Comparison between electrical, pneumatic and mechanical control • Safety factors, potential hazards in the work area • Energy costs • Component costs • Maintenance requirements • Environmental factors – where the system will be situated • Physical size of different systems • Need to change / adjust the system for different tasks 	6		<p>Level 3 (5-6 marks) Shows detailed understanding of reasons for choosing a particular type or combination of types for a control system. 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>Level 2 (3-4 marks) Shows some understanding benefits and drawbacks of different types of system 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>Level 1 (1-2marks) Shows limited understanding of the principles of different types of system or reasons for choice. 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>0 Response worthy of no marks.</p>
TOTAL			15		

Question	Answer	Mark	Guidance
<p>19 (a) (i)</p>	<p>The diagram shows three solenoid valves, labeled valve A, valve B, and valve C. Each valve has a solenoid coil and a return spring. The solenoid coils are connected to the outputs of a Programmable Controller. The controller has three outputs labeled 1, 2, and 3, and three inputs labeled 1, 2, and 3, plus a common terminal. Output 1 is connected to valve A, output 2 to valve B, and output 3 to valve C. All return paths from the valves are connected to the common terminal of the controller.</p>	<p>3</p>	<p>Connections from controller outputs to individual solenoids, 1 mark Return path from all solenoids connected, 1 mark Return paths all connected to common, 1 mark. Either common connection on the controller can be used.</p>
<p>(ii)</p>	<p>Tests for fault should include:</p> <ul style="list-style-type: none"> • Direct connection of solenoid to power supply to see if solenoid is operating • Use of multimeter on volt setting measuring between output 2 and common when output 2 is switched on • Check on program of controller to ensure that output 2 is switched on • Use of multimeter on resistance setting to test connecting wires for continuity. <p>Description that includes: three tests, 3 mark, two tests, 2 marks, one test, 1 mark.</p>	<p>3</p>	<p>Allow any other valid test. Allow 2 marks for full description of one test. Allow 3 marks for full description of two tests.</p>

Question	Answer	Mark	Guidance
(b)	Advantages could be: <ul style="list-style-type: none"> • The system will operate indefinitely with no manual intervention • The random action is more reliable than using human choice • Programming of the timing of target appearance can be altered • Once installed the system operating costs will be lower than using manual control. 2 x 1 marks	2	Allow any other valid advantage
(c)	Connection from either microswitch terminal to input 1,2, or 3, 1 mark Connection from remaining microswitch terminal to common, 1 mark 	2	
(d)	The bend would be formed using a line bender / strip heater, 1 mark Description of the process to include bending around a wooden former to ensure an even bend, 1 mark.	2	
(e)	Rearrangement of formula to give $P = F/A$, 1 mark Substitution into formula, $P = 50 / \pi \times 12.5^2$, 1 mark $P = 50/490.87 = 0.1N/mm^2$, 1 mark.	3	Award 3 marks for correct answer with no working.
TOTAL		15	

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