

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 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

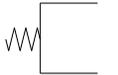
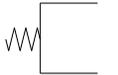
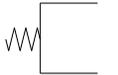
Annotation	Meaning
	Blank Page – this annotation must be used on all blank pages within an answer booklet (structured or unstructured) and on each page of an additional object where there is no candidate response.
	Level 1
	Level 2
	Level 3
	Noted but no credit given
	Tick

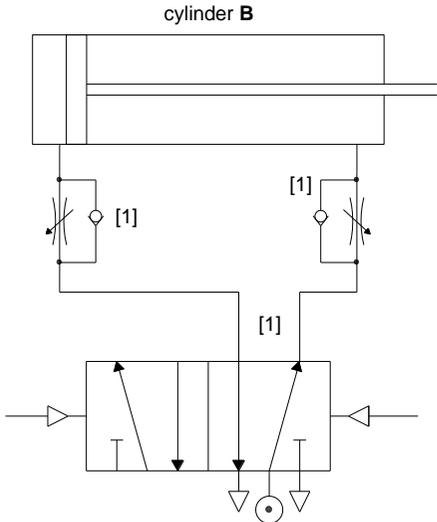
Question		Answer	Mark	Guidance
1		(c)	1	
2		(c)	1	
3		(b)	1	
4		(d)	1	
5		(c)	1	
6		The Earth's core, or information about the decay of radioactive minerals resulting in heat under the earth's crust	1	Accept 'activity in rocks' Not 'heat'. Not 'volcano'. – too vague.
7		Any of: <ul style="list-style-type: none"> • Landfill • Burning • Littering 	1	Allow other legitimate answers
8		Primary	1	
9		Planned or built-in obsolescence	1	Allow for misspelling
10		Ergonomics	1	
11		False	1	
12		False	1	
13		True	1	
14		True	1	
15		False	1	
16	(a)	Any of: <ul style="list-style-type: none"> • Waterproof • Shock/impact resistant/durable • Transparent/see-through • De-mountable via fitting • Positive closure clip • Operating button(s) 	3	Allow: Moveable / adjustable Secure mount to helmet Aerodynamic Fit any helmet Lightweight Compact
	(b)	Environmental benefits, any of: <ul style="list-style-type: none"> • No disposal of primary cells • Toxic material not put in landfills • Less energy used to recharge than to remanufacture • Often have a higher capacity than primary • Can be re-used 100-1000 times • Reduction in single-use batteries made 	2	Must be an environmental benefit, i.e. not cost

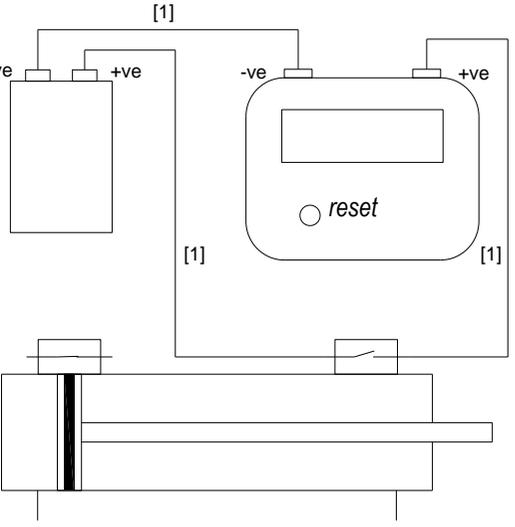
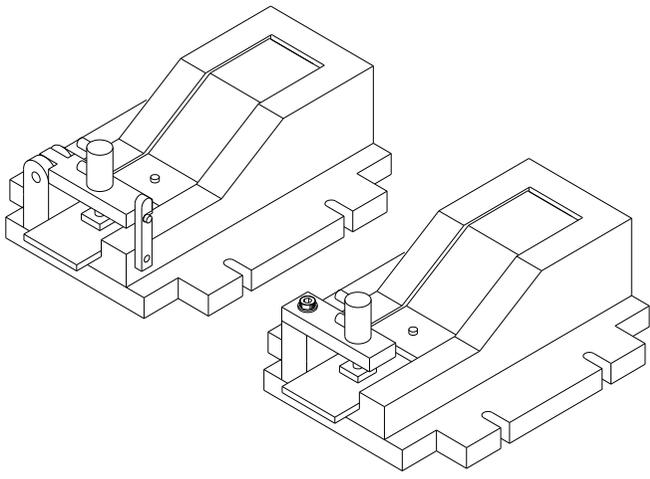
Question	Answer	Mark	Guidance
(c)	Parts identified as per question: <ul style="list-style-type: none"> • B • A • G • F 	4	
(d)	A safety line of some sort, fishing line, braided cord, strong string, stainless steel braided wire.	1	Accept any valid alternative. Not a safety suggestion like 'don't catch it in a dangerous situation'. Must retain camera, i.e. Not impact resistant case.
(e)	Features shown may include: <ul style="list-style-type: none"> • for protection • interior • parts cut out • features • / processes 	[4]	Any 4 marks from 5.

Question		Answer	Marks	Content	Guidance
					Levels of response
	(f)*	<p>Candidates should use examples when illustrating their points. Answers should relate to these examples rather than generic text explaining the process.</p> <p>Answers should relate how CAM would enable quicker prototyping with greater accuracy. Comments about saving materials are valid if reasonably qualified but catch-all like 'quicker' or 'cheaper' are not worthy unless qualified.</p> <ul style="list-style-type: none"> • CAD / CAM • computer simulation to show how parts interact • rapid prototyping of parts to make working prototype e.g. 3D printing. • Appropriate use of IT. 	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 using CAD / CAM can reduce development time. 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 using CAM can reduce development time. 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 using CAM can reduce development time. 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> <p>(0) response worthy of no marks</p>

Section B

Question		Answer	Mark	Guidance								
17	(a) (i)	Reciprocating / reciprocation, 1 mark	1									
	(ii)	The sequence is A+ B+ B- A-.	1	Must be all correct for the mark.								
	(b)	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%;">name</th> <th style="width: 50%;">symbol</th> </tr> </thead> <tbody> <tr> <td>A pressure source</td> <td> [1]</td> </tr> <tr> <td>B ...spring return [1]...</td> <td></td> </tr> <tr> <td>C bi-directional restrictor [1] [1]</td> <td></td> </tr> </tbody> </table>	name	symbol	A pressure source	 [1]	B ...spring return [1]...		C bi-directional restrictor [1] [1]		4	Allow bi-directional flow control valve
name	symbol											
A pressure source	 [1]											
B ...spring return [1]...												
C bi-directional restrictor [1] [1]												
	(c) (i)	(5) → 4 → 1 → 6 → 3 → 2	4	All correct 4 marks, 1 mark for each pair correct. 1 mark for each correct box – maximum 4 Do not allow repeat answers - no marks should be awarded for repeated numbers, even if one of the answers is correct.								
	(ii)	Benefits could include: <ul style="list-style-type: none"> • Easy connection to PLC • More compact circuit • No need for adjustment to roller valve position • Can be re-programmed • Electronic components cost less than pneumatic components. 	2	1 mark for each valid benefit Allow reference to reliability if qualified. No marks for 'faster'.								

Question	Answer	Mark	Guidance
	<p>(iii)</p> 	<p>3</p>	<p>1 mark for use of unidirectional restrictors. 1 mark for correct orientation of restrictors. 1 mark for correct connections to 5/2 valve.</p>
<p>18 (a)</p>	<p>(i) The logic function is AND.</p>	<p>1</p>	
	<p>(ii) Using the AND function two valves have to be operated simultaneously for the signal to go to the cylinder. This will normally be two pushbuttons operated using both hands, this ensures that hands are clear of the working area.</p>	<p>2</p>	<p>Allow marks for understanding shown.</p>
	<p>(iii) Button positions shown either side of machine, 1 mark. In positions where it is not possible to operate both with one hand, 1 mark.</p>	<p>2</p>	<p>Allow 1 mark for buttons on the same side but far enough apart to need two hands to operate.</p>
<p>(b)</p>	<p>(i) Explanation may include:</p> <ul style="list-style-type: none"> • The reed switch cylinder will not interfere with the riveting operation • Limit switch could move out of position and fail to register on count • No exposed electrical parts • Less chance of contact bounce giving a false reading. 	<p>3</p>	<p>Clear explanation mentioning two points, 3 marks. Clear explanation mentioning one point, 2 marks. Single point with no justification, 1 mark.</p>

Question	Answer	Mark	Guidance
(ii)		3	<p>1 mark for each correct connection.</p> <p>Switch can be in 0V / -ve line.</p>
(c)		4	<p>Clamp can be moved, 1 mark</p> <p>No interference with cylinder B movement, 1 mark</p> <p>Functional design, 1 mark</p> <p>Work piece will be secure, 1 mark</p>

Question			Answer	Marks	Guidance
19	(a)	(i)	Explanation could include: <ul style="list-style-type: none"> To test operation of the circuit Prototype systems allow easy changes to be made Parts are held securely and safely on base Will give a clear indication of problems in the circuit. May be much smaller than the final design 	2	Clear explanation mentioning two points, 2 marks. Single point with no justification, 1 mark. Single point with clear justification, 2 marks. Allow 'decrease of risks in the circuit'.
		(ii)	Benefits of CAD simulation software will include: <ul style="list-style-type: none"> Rapid movement/email between designer and client / more than one person can work on it. No damage can be done to components Range of valves / components available Instant testing 2 x 1 marks for suitable benefits.	2	Allow other valid benefits Do not accept quick set up Allow 'less room for human error when setting up'.
		(iii)	Reasons for using standard sized parts include; <ul style="list-style-type: none"> Parts from different manufacturers can be connected Standard threads on connectors mean fewer components have to be stocked / stored Repair of parts is easier because of ready availability of spare parts 2 x 1 marks for suitable reasons.	2	Allow cost benefits.
	(b)		Correct calculation of the piston area, 1 mark $3.142 \times 15^2 = 706.95\text{mm}^2$. Conversion from bar to N/mm^2 , 1 mark $5 \times 0.1 = 0.5\text{N/mm}^2$ Use of formula $F = P \times A$, 1 mark $0.5 \times 706.95 = 353.475\text{N}$	3	Allow variations in the value of pi used in the calculation.

Question		Answer	Marks	Guidance	
				Content	Levels of response
	(c)*	<p>Safety aspects for consideration will include:</p> <ul style="list-style-type: none"> • Properties of materials that can be used for components • Maximum working pressure that can be applied to components • Conditions of use, heat, humidity, cold • Recommendations for inspection period • Instructions supplied with equipment • Legal requirements for safety • Training for users of the equipment • Traceability of materials used for manufacture • Operation of safety valves and regulators • BS / ISO testing and recommendations for pneumatic equipment 	6		<p>Level 3 (5-6 marks) Shows detailed understanding of safety aspects in pneumatic equipment. 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 of safety aspects in pneumatic equipment. 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 safety aspects in pneumatic equipment. 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>

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