

# **Design and Technology**

General Certificate of Secondary Education

Unit **A514/02** Electronics: Pneumatics

## **Mark Scheme for June 2013**

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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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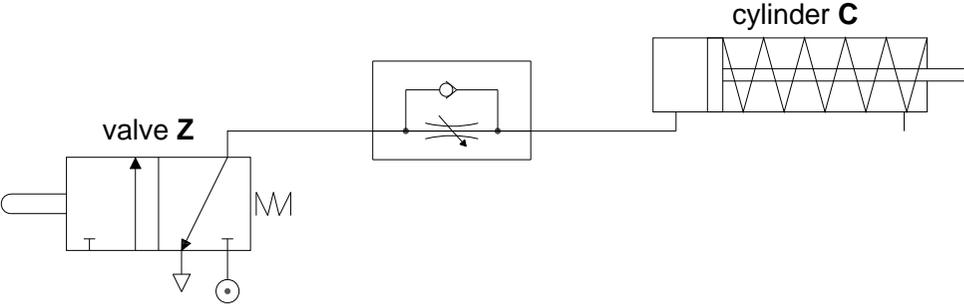
1. Annotations

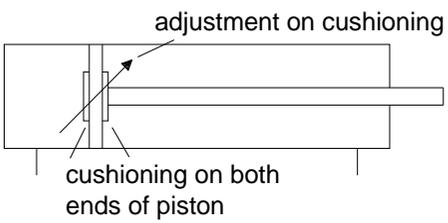
Annotation	Meaning
	correct response
	incorrect response
	Benefit of doubt
	No benefit of doubt
	= Too Vague

Question		Answer	Marks	Guidance								
1	(a)	<table border="1"> <thead> <tr> <th>component name</th> <th>component symbol</th> </tr> </thead> <tbody> <tr> <td>A double acting cylinder</td> <td> </td> </tr> <tr> <td>B pressure gauge</td> <td> </td> </tr> <tr> <td>C plunger operated [1] ..... spring return 3/2 valve [1] .....</td> <td> </td> </tr> </tbody> </table>	component name	component symbol	A double acting cylinder		B pressure gauge		C plunger operated [1] ..... spring return 3/2 valve [1] .....		2	1 mark for two connections shown, 1 mark for piston with no return spring.
	component name	component symbol										
A double acting cylinder												
B pressure gauge												
C plunger operated [1] ..... spring return 3/2 valve [1] .....												
	(b) (i)	<p>Reasons for applying finishing processes to pneumatic components could include:</p> <ul style="list-style-type: none"> <li>• protection from corrosion / increases working life of component.</li> <li>• reduction in maintenance</li> <li>• improve the working properties of the component</li> <li>• colour coding of components.</li> </ul> <p>2 x 1 marks</p>	2	Do not accept anything other than plunger operated.  Accept either spring return or 3 port or 3/2 valve								
			2	Allow aesthetic improvement.								

Question		Answer	Marks	Guidance
	(ii)	The maximum air pressure that can be used with the component <b>B</b> is 8 bar or 116 psi.	1	Do not allow 'working pressure is 8 bar'.
	(iii)	Uni-directional restrictor (component <b>A</b> ) restricts air entering the reservoir (1), it is adjustable to allow different lengths of delay (1). Reservoir (component <b>B</b> ) fills with air from the restrictor (1), when pressure in reservoir is equal to working pressure the delay is complete (1).	4	Component names do not have to be known to gain marks.
<b>Total</b>			<b>12</b>	

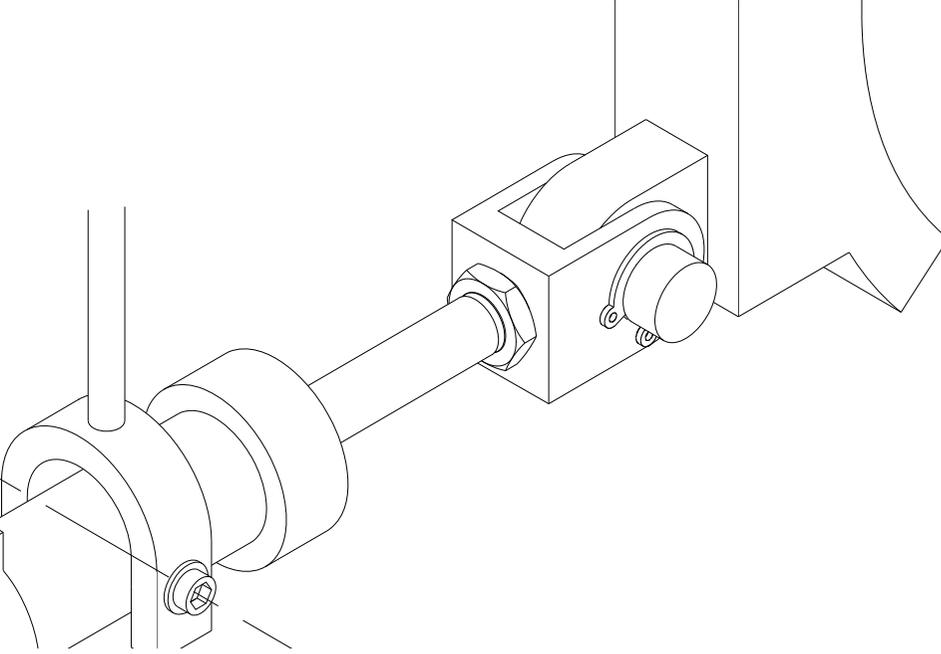
Question		Answer	Marks	Guidance
2	(a) (i)	When valve <b>Y</b> is pressed valve <b>W</b> changes state (1) and main air passes through it to outstroke cylinder <b>A</b> (1) where it will stay (1) until valve <b>X</b> is pressed and the cylinder will instroke (1) Valve <b>Y</b> will lower the arm and valve <b>X</b> will raise the arm (1) 4 x 1 marks	4	Activating <b>Y</b> will lower the grab arm; activating <b>X</b> will raise the grab arm. Give 1 mark for using incorrect valve to operate the DAC (raising and lowering reversed).
	(ii)	The force on the instroke is acting on a slightly smaller surface area, $\emptyset$ piston – $\emptyset$ piston rod.	1	Allow mark for understanding shown.
	(b)	1. when valve <b>Z</b> is pressed cylinder <b>C</b> outstrokes (1) 2. and closes the grab (1) 3. valve <b>Z</b> will need to remain pressed to hold the drink (1) or 4. when the arm has been moved to the drop zone valve <b>Z</b> can be released and the can will drop (1). 3 x 1 marks.	3	

Question	Answer	Marks	Guidance
(c)	<p>Restrictor correct way around (1), correct position between <b>Z</b> and <b>C</b> (1)                      Correct connections to <b>Z</b> and <b>C</b> (1), Accurate drawing of restrictor (1) 4 x 1 marks</p> 	4	Ignore any extra valve attached to cylinder <b>C</b> .
	<b>Total</b>	<b>12</b>	

Question		Answer	Marks	Guidance
3	(a) (i)	 <p>The piston in a non-cushioned cylinder can slam against either end of the cylinder causing wear (1), an air cushion will slow down the piston just before the end of the movement (1) The cushioning effect can be adjusted with a needle valve (1)</p> <p>The piston in a non cushioned cylinder can cause damage if they come to a sudden stop (1).</p> <p>2 x 1 marks for any two valid points given in description.</p>	2	Allow marks for either sketch with annotation or for written description.
	(ii)	<p>Reasons given could include the following points:</p> <ul style="list-style-type: none"> <li>• computer simulation may not include cushioned cylinders</li> <li>• could be difficult for simulation to show the effect of cushioning as it will be running slower than real time</li> <li>• would cost more to implement in the software so not included.</li> </ul> <p>1 marks for valid reason</p>	1	Allow marks for other valid reasons.
	(b) (i)	<p>If a vacuum cup is brought into contact with a flat surface of the can (1) it will grip it because of the holding force the vacuum has created through the sealed contact with the can (1). 2 x 1 marks for clear descriptive points.</p>	2	Allow marks for other valid points.
	(ii)	<p>The pressure/vacuum switch will need to be set to vacuum (1).</p>	1	

Question		Answer	Marks	Guidance	
				Content	Levels of response
	(c)*	<p>Discussion could include the following points:</p> <ul style="list-style-type: none"> <li>• nature of what is to be controlled</li> <li>• can system be operated remotely or must it be permanently connected to power</li> <li>• how much noise will the control system generate</li> <li>• energy used in production of system components</li> <li>• fuels involved in operating the control system/providing power</li> <li>• can system operate using renewable energy sources</li> <li>• can system components be recycled or reused.</li> </ul>	6	Allow use of other suitable points.	<p><b>Level 3 (5–6 marks)</b> Shows detailed understanding of the comparisons between electronic and pneumatic systems and analyses most of the issues involved. 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 the comparisons between electronic and pneumatic systems with some analysis of the issues involved. 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 (1–2 marks)</b> Shows limited understanding of the comparisons between electronic and pneumatic systems. 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>

Question			Answer	Marks	Guidance	
					Content	Levels of response
						<b>0</b> Response worthy of no marks.
			<b>Total</b>	<b>12</b>		

Question	Answer	Marks	Guidance
4 (a) (i)	 <p>Fixing to piston rod (1), locknut used (1) Fixing to grab allowing movement (1) Circlip/nut and bolt shown (1) Material used (1) Functional design (1) 5 x 1 marks, for any five of the above features correctly completed.</p>	5	Variety of methods could be used. A functional solution must allow oscillating movement between piston rod and grab arm.
(ii)	The linkage should be operated by hand to endure that it can move correctly.	1	Allow other valid check e.g. safe working pressure.

Question			Answer	Marks	Content	Guidance
						Levels of response
			<p>Discussion could include the following points:</p> <ul style="list-style-type: none"> <li>• parts/fixings can be standardised</li> <li>• components easily available from catalogues/on line suppliers</li> <li>• easy replacement when servicing</li> <li>• components not always exactly what is required, can mean compromise in</li> <li>• reduced cost through increased production runs on components</li> <li>• range of suppliers, no restriction to a single source, helping to reduce costs</li> <li>• proven function of components.</li> </ul>	6	List of issues involving pre-manufactured components is not exhaustive.	<p><b>Level 3 (5–6 marks)</b> Shows detailed understanding of issues involved with pre-manufactured components and analyses most of the issues involved. 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 the issues with pre-manufactured components with some analysis of the issues involved. 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 (0–2 marks)</b> Shows limited understanding of the issues with pre-manufactured components. 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>
			<b>Total</b>	<b>12</b>		

Question		Answer	Marks	Guidance
5	(a) (i)	The receiver/reservoir receives the compressed air from the compressor (1) and stores it for the circuit to use (1) it also maintains a constant supply pressure (1). 2 x 1 marks.	2	Any two points can be used.
	(ii)	The safety valve is set to open at a preset pressure (1) it vents any dangerous increase in pressure to atmosphere (1).	2	
	(iii)	The electric motor turns the compressor shaft (1) which then moves the piston(s) which compress the air (1).	2	
	(b) (i)	It is necessary to use a reed switch cylinder in a micro controlled system because the controller needs feedback (1) the piston has a magnetic ring which closes the reed switch when influenced by the magnet this sends feedback to the microcontroller (1).	2	
	(ii)	Benefits could be: <ul style="list-style-type: none"> <li>• very small compared to the microswitch</li> <li>• no mechanical components to fail</li> <li>• QTC withstands a greater force</li> <li>• analogue response allows some 'feel' on the grab arm</li> <li>• low cost of QTC pellet compared to microswitch.</li> </ul>	2	Terms like 'small' or 'cheap' must be justified.
	(iii)	The microswitch is a digital device and is either very high or very low resistance (1) the QTC switch has a falling resistance as more force is applied (1). This varying resistance makes it possible to adjust the amount of force applied (1) and control the strength of the grip (1).	2	Any two points from those listed.
<b>Total</b>			<b>12</b>	

**OCR (Oxford Cambridge and RSA Examinations)**  
**1 Hills Road**  
**Cambridge**  
**CB1 2EU**

**OCR Customer Contact Centre**

**Education and Learning**

Telephone: 01223 553998

Facsimile: 01223 552627

Email: [general.qualifications@ocr.org.uk](mailto:general.qualifications@ocr.org.uk)

**[www.ocr.org.uk](http://www.ocr.org.uk)**

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