

# **Design and Technology**

General Certificate of Secondary Education **A514/01**

Electronics: Technical Aspects of Designing and Making

## **Mark Scheme for June 2010**

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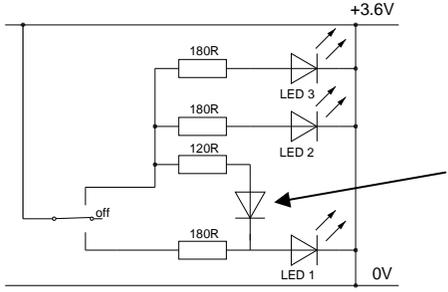
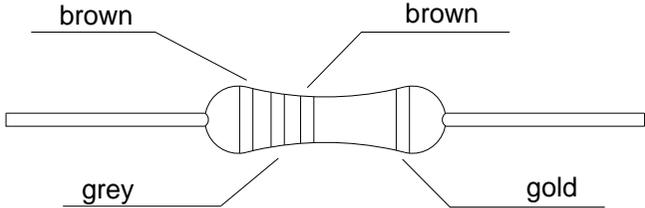
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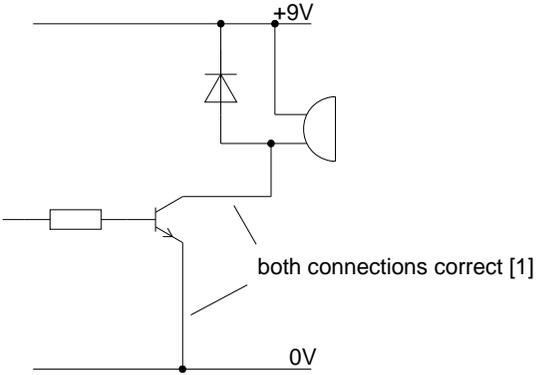
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Question	Expected Answer	Mark	Additional Guidance
1 (a)	Ergonomic factors could include: <ul style="list-style-type: none"> <li>• Side grips;</li> <li>• Rotating end to charging handle;</li> <li>• Either left or right hand use;</li> <li>• Different levels of light available;</li> <li>• Rounded shape to fit into hand.</li> </ul> 1 mark for suitable <b>ergonomic</b> factor.	[1]	Allow any other suitable ergonomic factor.
(b) (i)	Diode inserted as shown below; 1 mark for diode symbol, 1 mark for orientation. <div style="text-align: center;">  </div>	[2]	No mark for LED symbol.
(ii)	Lower value of resistor is needed because of: voltage drop across diode (0.7V), 1 mark, to achieve same level of light from all LEDs, 1 mark.	[2]	Allow one mark for understanding shown. Allow one mark for 'protect LED'
(iii)	1 mark for value, 1 mark for tolerance. <div style="text-align: center;">  </div>	[2]	

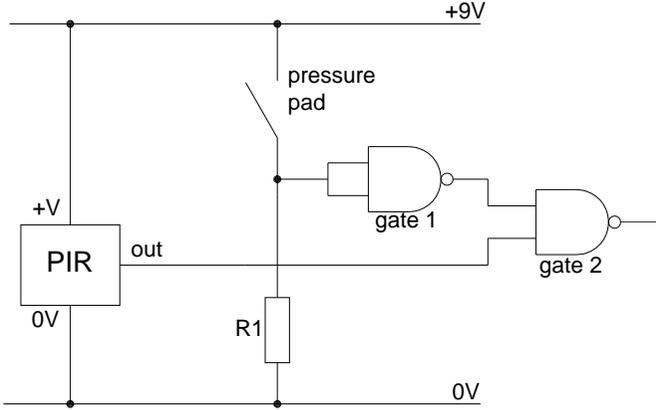
Question		Expected Answer	Mark	Additional Guidance
	(c)	Reasons for using a screen layer will include: <ul style="list-style-type: none"> <li>• Information on component position;</li> <li>• Information on component value;</li> <li>• Component orientation.</li> </ul> 1 mark for valid reason	[1]	
	(d)	Use of voltage drop, 1 mark. $3.6 - 1.8 = 1.8$ Substitution and calculation for current, 1 mark. $I = 1.8/180 = 0.01A$ or 10mA. Battery is rated at 40mAh. Torch will operate for $40/10 = 4$ hours, 1 mark.	[3]	Allow ECF for marks 2 and 3. 0.01A or 10mA no working 2 marks 4 hours no working 1 mark.
	(e)	Environmental benefit could include: <ul style="list-style-type: none"> <li>• No battery replacement;</li> <li>• Long lasting system;</li> <li>• No external power source needed to recharge battery.</li> </ul>	[1]	Allow mark for any other valid reason.
		<b>TOTAL</b>	<b>[12]</b>	

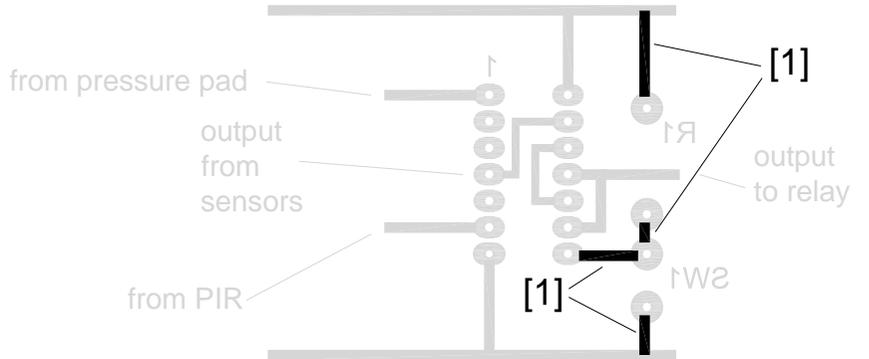
Question			Expected Answer	Mark	Additional Guidance
2	(a)	(i)	<p>1 mark each for power connections as shown.</p>	[2]	<p>Crossed wires are allowed. Ignore any extra connections not directly affecting the power connections or Reset connections in 2(a)(ii).</p>
		(ii)	4K7 resistor, 1 mark. Switch ,1 mark.	[2]	Symbol position may vary.
		(iii)	Darlington array is to <b>amplify</b> or <b>increase current</b> from output to allow other devices to be operated. 1 mark	[1]	<p>Allow mark for understanding shown. Allow mark for 'switching'.</p>
	(b)	(i)	Segments <b>a,b,c,d,g</b> will be lit.	[1]	Allow mark for shaded segments.
		(ii)	Pin value = $1+2+4+8+64 = 79$ , 1 mark.	[1]	Allow mark for correct value relating to incorrect segments in (i).
	(c)		<p>Benefits of ribbon cable will include:</p> <ul style="list-style-type: none"> <li>• Main circuit will not interfere with positioning of display;</li> <li>• Can be unplugged for working on main board;</li> <li>• Display can fit in smaller space than required by main board;</li> <li>• Display can be in separate casing.</li> <li>• Ribbon cable is flexible</li> <li>• Wires will not tangle</li> </ul> <p>1 mark each for 2 benefits. 2 x 1</p>	[2]	

Question		Expected Answer	Mark	Additional Guidance
	(d)	Stages in soldering process will include: <ul style="list-style-type: none"> <li>• Ensure that pads are clean and free from corrosion;</li> <li>• Placing tip of iron on joint to heat pin and pad;</li> <li>• Allow heat to conduct to pin and pad;</li> <li>• Feed solder into joint;</li> <li>• Check joint (for any bridged or dry joints).</li> <li>• Cleaning the tip of the iron.</li> <li>• Tinning the iron</li> </ul> 1 mark each for three clear stages described, 3 x 1.	[3]	Order of statements does not matter.
		<b>TOTAL</b>	[12]	

Question			Expected Answer	Mark	Additional Guidance
3	(a)	(i)	Components are <b>C1</b> and <b>VR1</b> , 1 mark for each.	[2]	Accept <b>electrolytic capacitor</b> or <b>variable resistor</b> or <b>potentiometer</b> .
		(ii)	Reasons could include: <ul style="list-style-type: none"> <li>• More accurate delay;</li> <li>• Can be reprogrammed easily / versatile;</li> <li>• Long delays possible.</li> </ul> 1 mark each for two valid reasons. 2 x 1	[2]	No marks for cost related reasons. Allow '555 is not adjustable'.
	(b)	(i)	Emitter and collector connections both correct, 1 mark. 	[1]	Ignore any extra connections not directly connected to the response area.
		(ii)	Setting dial arrow must point toward <b>Hfe</b> on scale, 1 mark.	[1]	

Question	Expected Answer	Mark	Additional Guidance
(c)	<p>Benefits for using a CAD simulation could include:</p> <ul style="list-style-type: none"> <li>• Variety of components available;</li> <li>• Test instruments can be connected easily;</li> <li>• Speed of the simulation can be slowed down for easy viewing;</li> <li>• Accuracy of simulation;</li> <li>• Component values can be altered easily;</li> <li>• Can be converted directly into a PCB;</li> <li>• Results can be saved and/or exported for manufacture;</li> <li>• Real components are not damaged – cost saving.</li> </ul> <p>Drawbacks could include:</p> <ul style="list-style-type: none"> <li>• Cannot always get realism in test, eg heat, light.</li> <li>• Some components not available;</li> <li>• More expensive to set up than using a breadboard</li> </ul> <p><b>Level 1 (0-2) marks</b> Basic comments discussing some of the benefits of CAD design, must relate to circuits. At least <b>one of the above benefits</b> mentioned.</p> <p><b>Level 2 (3-4)</b> Adequate discussion, showing understanding of the use of CAD for circuit design. At least <b>two specific benefits mentioned and one drawback.</b></p> <p><b>Level 3 (5-6)</b> Clear discussion comparing benefits and drawbacks of CAD design. Mention of benefits in manufacturing and the <b>ease of testing</b> with a range of component values.</p>	[6]	
		TOTAL	[12]

Question	Expected Answer	Mark	Additional Guidance																									
<p>4 (a) (i)</p>	<p>1 mark for each gate correctly connected, 2 x 1.</p> 	<p>[2]</p>																										
	<p>(ii) Pressure pad column correct, 1 mark.</p> <table border="1"> <thead> <tr> <th></th> <th>pressure pad</th> <th>inverted signal (gate 1 output)</th> <th>PIR sensor</th> <th>combined signal (gate 2 output)</th> </tr> </thead> <tbody> <tr> <td></td> <td>1</td> <td>0</td> <td>0</td> <td>1</td> </tr> <tr> <td></td> <td>1</td> <td>0</td> <td>1</td> <td>0</td> </tr> <tr> <td></td> <td>0</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td></td> <td>0</td> <td>1</td> <td>1</td> <td>0</td> </tr> </tbody> </table>		pressure pad	inverted signal (gate 1 output)	PIR sensor	combined signal (gate 2 output)		1	0	0	1		1	0	1	0		0	1	0	0		0	1	1	0	<p>[1]</p>	
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Question	Expected Answer	Mark	Additional Guidance
(b) (i)	 <p>R1 connected correctly, 1 mark. SW1 connected correctly, 1 mark.</p>	[2]	
	(ii) Labels are reversed because viewed from the top of board, they will be correct from component side, 1 mark. for understanding shown.	[1]	Allow mark for understanding shown.
(c)	<p>Contributions to sustainability could include:</p> <ul style="list-style-type: none"> <li>• Using recycled materials;</li> <li>• Minimum amount of materials;</li> <li>• Reducing energy needs during use;</li> <li>• Reducing energy requirements during manufacture and use;</li> <li>• Designing for repair and maintenance;</li> <li>• Designing with recycling in mind;</li> <li>• Reducing the transport distance for finished goods by manufacturing locally.</li> </ul> <p>Allow other valid examples used in explanation. 1 mark for each valid point made in explanation.</p> <p><b>Level 1 (0-2) marks</b> Basic comments explaining <b>one aspect of sustainability</b> and <b>drawing on one of the above points.</b></p>		

Question		Expected Answer	Mark	Additional Guidance
	(c)	<p><b>Level 2 (3-4)</b> Adequate explanation, showing understanding of energy usage during manufacture and during use. At least <b>two specific points mentioned</b>.</p> <p><b>Level 3 (5-6)</b> Clear explanation showing a broad view of sustainability and the part played by designers rather than manufacturers. <b>Two or more points clearly explained</b>.</p>	[6]	
		<b>TOTAL</b>	[12]	

Question			Expected Answer	Mark	Additional Guidance
5	(a)	(i)	The potentiometer allows voltage at the inverting input to be adjusted, 1 mark.	[1]	Allow mark for any reference to setting value, sensitivity or adjustment of switching point.
		(ii)	If the LED is left in the final circuit it will allow the switching point to be set easily without the need for test instruments. 1 mark for understanding shown.	[1]	Allow mark for understanding shown.
		(iii)	Using the formula the voltage at the centre of the LDR/VR1 is $220/387 \times 9 = 5.1$ . Voltage at centre of 10K resistors is 4.5. Inverting input is greater than non-inverting so output is low and LED is off. 1 mark for calculating values using formula. 1 mark for understanding working of comparator. 1 mark for use of values in explanation.	[3]	
	(b)	(i)	Substitution into formula, $50 = I \times 12$ , 1 mark. Calculation using correct values, $50/12 = 4.1666A$ , 1 mark. Accept <b>4.16A</b> , <b>4.17A</b> , <b>4.2A</b> . Correct answer with no working, 2 marks.	[2]	
		(ii)	<b>5A</b> fuse. Allow ECF for incorrect result in (b)(i)	[1]	Allow any indication of fuse used. For ECF units must appear in (b)(i).
		(iii)	Correct relay is RL – 024. Allow mark if indication is made direct onto table.	[1]	
	(c)		Use of workable method, eg mounting pillars, screws/spacers etc, 1 mark. Clear description of how the item is used, either in note or sketch form, 1 mark. Inclusion of detail, size of holes, size of screws, etc, 1 mark.	[3]	Allow one mark only for use of given screw holes.
			<b>TOTAL</b>	[12]	

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