

Design and Technology

General Certificate of Secondary Education

Unit **A514/01** Electronics: Technical Aspects of Designing and Making

Mark Scheme for January 2011

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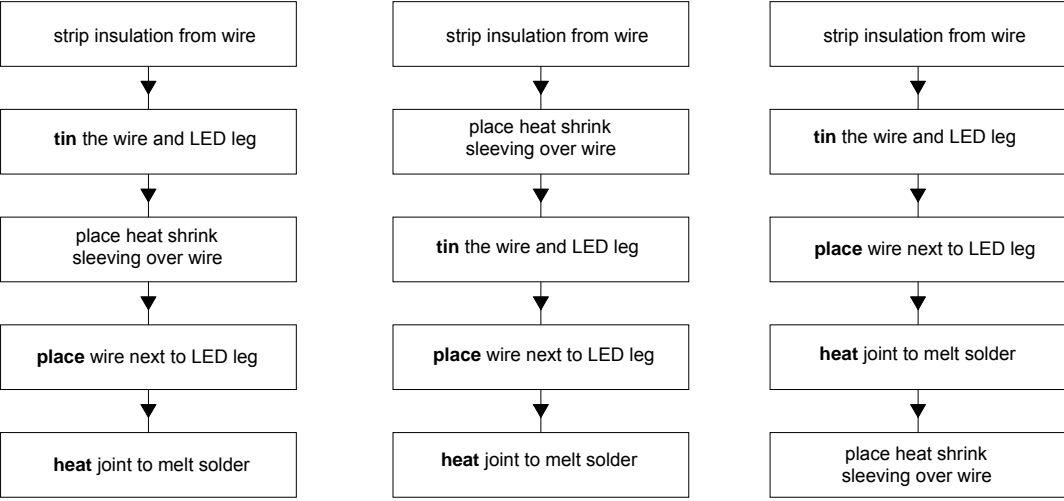
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Question			Expected Answer	Mark	Rationale
1	(a)	(i)	The most suitable wire is black 7/0.2mm. Allow any method of indication, in list or on diagram.	[1]	
		(ii)	Reasons for choice to be: <ul style="list-style-type: none"> Black to indicate negative for the cathode leg or 7 stranded wires are flexible and will allow movement of LED. 	[1]	Allow a good reason for choice of other wires.
	(b)	(i)	Benefits of heat shrink sleeving should include: <ul style="list-style-type: none"> Will increase strength of joint Insulation of legs from each other Colour coding of leg. 2 x 1 marks	[2]	Allow reference to security of joint or 'tidier' joint.
		(ii)	Procedures for dealing with burns should include: <ul style="list-style-type: none"> Cool with water Report incident to teacher / seek medical advice Make sure that soldering iron is placed back safely in stand. 2 marks for two points mentioned.	[2]	Allow 2 marks for one point well described.

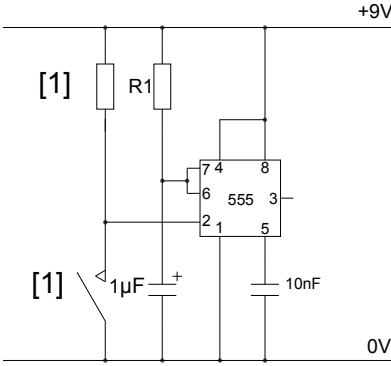
Question	Expected Answer	Mark	Rationale
<p>1 (b) (iii)</p>	<p>2 marks for all correct. 1 mark for heat shrink statement in suitable position.</p>  <pre> graph TD subgraph Flowchart 1 A1[strip insulation from wire] --> B1[tin the wire and LED leg] B1 --> C1[place heat shrink sleeving over wire] C1 --> D1[place wire next to LED leg] D1 --> E1[heat joint to melt solder] end subgraph Flowchart 2 A2[strip insulation from wire] --> B2[place heat shrink sleeving over wire] B2 --> C2[tin the wire and LED leg] C2 --> D2[place wire next to LED leg] D2 --> E2[heat joint to melt solder] end subgraph Flowchart 3 A3[strip insulation from wire] --> B3[tin the wire and LED leg] B3 --> C3[place wire next to LED leg] C3 --> D3[heat joint to melt solder] D3 --> E3[place heat shrink sleeving over wire] end </pre>	<p>[2]</p>	<p>Heat shrink can be placed in boxes 3,2, or 5. Connection statements must be in correct order for mark: Tin – Place - Heat</p>
<p>(c) (i)</p>	<p>D1 gives spacing of the pins which are needed for pad positioning or pad size, 1 mark. D2 gives the depth of the terminal block which is needed to ensure that other components have enough room, or that there is room to fit wires, 1 mark.</p>	<p>[2]</p>	
	<p>(ii) Checks should include:</p> <ul style="list-style-type: none"> • No stray strands sticking out • Insulation going right up to hole in terminal block • No sharp bends in connecting wires • Make sure that screws are tight / wires secure. <p>Allow other valid checks, 2 x 1 marks.</p>	<p>[2]</p>	
Total		[12]	

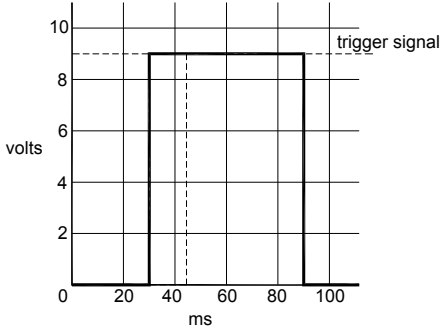
Question			Expected Answer	Mark	Rationale
2	(a)	(i)	Benefits of LED display could be: <ul style="list-style-type: none"> • Bright and easy to see • Available in different sizes • Available in different colours • No backlight needed • Lower cost than LCD; do not allow cheap, must be qualified for mark. Allow other valid benefits, [1] Benefits of LCD display could be: <ul style="list-style-type: none"> • Lower current draw, battery will last longer • Different shapes / symbols are available • Longer message / number is possible. Allow other valid benefits, [1] <p style="text-align: right;">2 x 1 marks</p>	[2]	Allow 'robust', or 'lasts a long time' for LED.
		(ii)	The highest decimal number possible with BCD is 9 .	[1]	
	(b)		The count is using a single digit display which will not go beyond 9, the number of birds being counted could be higher.	[1]	
	(c)	(i)	Benefits of DIL resistor network could include: <ul style="list-style-type: none"> • Quicker to fit • DIL socket can be used so value can be changed easily • Can save space on PCB compared to discrete resistors. 1 mark for suitable benefit.	[1]	
		(ii)	The counter output will be high so the common pin, the cathode, on the display should be connected to 0V, 1 mark. The output of the Darlington driver IC is open collector or 0V so the display for this must be changed to common anode, 1 mark.	[2]	

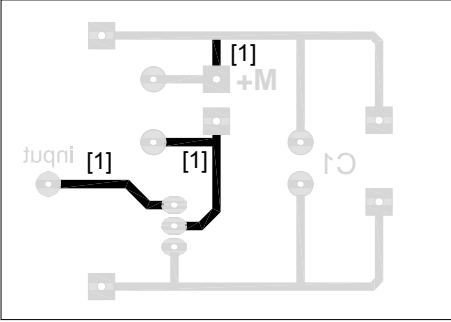
Question			Expected Answer	Mark	Rationale
2	(c)	(iii)	The resistance between two connected pins will be 0Ω . Accept resistance reading less than 3Ω . [1]		
		(iv)	The following methods are acceptable for identifying pins for each segment: Trial and error using a breadboard can be used; A multimeter on a low resistance setting will light the segments; Test lead with protective resistor connected to a battery. 2 marks for a clear description of a functional method, 1 mark for mention of a method with no clear indication of how it would be used.	[2]	
	(d)		Explanation may refer to: <ul style="list-style-type: none"> • Sensor does not rely on physical contact • Will not harm the birds that are being counted • Will work at all times of the day • Will not be affected by changing light levels due to cloud or sun. 2 marks for an explanation covering two aspects. 2 marks for one point well explained.	[2]	Allow 'can be hidden from / invisible to birds'.
			Total	12	

Question		Expected Answer	Mark	Rationale
3	(a)	The explanation must refer to the level of charge entering the battery or to the voltage being produced by the solar cell. If the voltage from the solar cell drops it means that there is little or no light available. 2 marks for clear understanding shown; 1 mark for inclusion of one valid point.	[2]	
	(b)	The charge in the battery has decreased because of the load from the LED. 1 mark for understanding shown.	[1]	
	(c) (i)	Reasons for using a bayonet type fitting could include: <ul style="list-style-type: none"> • Easy to assemble / take apart • No tools needed • Positive method, holds parts securely • Easy to take off if battery needs changing or circuit needs attention • Cuts the number of parts down, no screws needed. Reasons involving cost must be qualified to get a mark. 2 x 1 marks for valid reasons.	[2]	Allow justified reasons related to time of assembly.
	(ii)	The natural movement for tightening is clockwise; both parts use this movement to avoid confusion when assembling the light. 1 mark the reason given must relate to ergonomics.	[1]	
	(d)	Benefits for using solar power could include: <ul style="list-style-type: none"> • Less damage to the environment; clean and renewable • Rechargeable batteries will not need replacing as often • Little or no maintenance required • Costs of the photovoltaic / solar cell are falling as more are used • Can be used in remote areas where other methods are not feasible • No hard wiring required to an external source. Drawbacks could include: <ul style="list-style-type: none"> • Storage system is needed for use in low light levels • Bulky if higher voltage levels are required 	[6]	

Question	Expected Answer	Mark	Rationale
	<ul style="list-style-type: none"> • Can be expensive if higher voltages are required • Not useable or inefficient in some areas. <p>Level 3 (5-6 marks) Shows detailed understanding of the solar power issues involved 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>Level 2 (3-4 marks) Shows some understanding of the solar power issues involved with some analysis of the issues involved. 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>Level 1 (0-2marks) Shows limited understanding of the solar power issues involved. 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>Maximum of 2 marks for bullet point lists.</p>		
	Total	[12]	

Question	Expected Answer	Mark	Rationale
4 (a)	Latching solenoids will use less power than a constantly powered one. 1 mark.	[1]	
	(b) The circuit shown in Fig. 11 uses an electrolytic capacitor which will have a high tolerance. Extending the pulse time will ensure that even with the maximum tolerance the pulse will be 40ms long. Give mark for recognition of tolerance in components.	[1]	
(c) (i)	Substitution into formula, 1 mark. $0.06s = 1.1 \times 0.000001 \times R$, 1 mark. $R = \frac{0.06}{0.0000011} = 54545.45 \Omega = \mathbf{54.5K}$, 1 mark. Answer with no working 2 marks. Allow rounded values for result.	[2]	
	(ii) 100K	[1]	Allow mark for error carried forward.
	(iii) Resistor correctly placed 1 mark. PTM switch correctly placed 1 mark. Correct symbols incorrectly connected 1 mark. 	[2]	

Question			Expected Answer	Mark	Rationale
4	(c)	(iv)	If the trigger switch remains pressed the monostable output continues as it will re-trigger immediately at the end of the time period. 1 mark for understanding shown.	[1]	
	(d)		Output starting at 30ms and ending at 90ms, 1 mark. Amplitude of 9V, allow anything between 8V and 9V, 1 mark. Correct pulse drawn but starting in the wrong position, 1 mark. 	[2]	
	(e)		The changing output from the monostable (low to high) will latch the signal on the bistable, 1 mark. When the monostable output goes low at the end of the time period the output from the bistable remains high or latched , 1 mark.	[2]	
Total				[12]	

Question	Expected Answer	Mark	Rationale
5 (a)	<p>Input to gate, 1 mark; Drain to motor - pad and diode, 1 mark; Motor + to positive rail, 1 mark.</p> 	[3]	
(b)	<p>Use of a recognised method of holding PCB, 1 mark; could include nylon PCB mounts, screws, spacers, nuts to adjust height. Clear indication of where fixings are positioned on the PCB, 1 mark. PCB to be removable from the panel, 1 mark. Give marks for notes, sketches or a combination of communication methods.</p>	[3]	<p>If a screw is used allow mark for being removable. No marks for gluing.</p>
(c)	<p>Benefits for using photoetch could include:</p> <ul style="list-style-type: none"> • Proven method, equipment is available • Boards are robust and will stand a lot of handling / movement • Very accurate circuit can be used with surface mount and through hole components • Suited to high volume batch production. <p>Benefits for using conductive inks could include:</p> <ul style="list-style-type: none"> • Existing boards can be modified easily • Links can be printed on second layer instead of hard wired • Extra pads can be added • Circuit board can be flexible • Different backing materials possible • Suitable for low volume development work. 	[6]	

Question	Expected Answer	Mark	Rationale
	<p>Level 3 (5-6 marks) Shows detailed understanding of the PCB production issues involved 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>Level 2 (3-4 marks) Shows some understanding of the PCB production issues involved 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>Level 1 (0-2marks) Shows limited understanding of the PCB production issues involved. 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>Maximum of 2 marks for bullet point lists.</p>		
	Total	[12]	

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