

Cambridge National

Engineering

Unit **R113**: Electronic principles

Level 1/2 Cambridge National Award/Certificate in Systems Control in Engineering

Mark Scheme for June 2017

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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.







Mark schemes should be read in conjunction with the published question papers and the report on the examination.

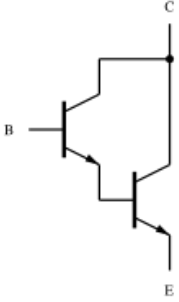
OCR will not enter into any discussion or correspondence in connection with this mark scheme.

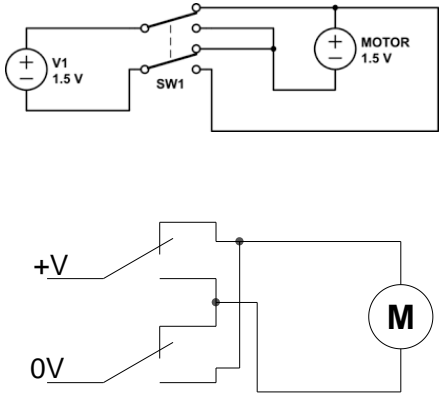
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These are the annotations, (including abbreviations), including those used in scoris, which are used when Marking

Annotation	Meaning of annotation
	Blank page
	Vague
	Tick
	Noted but no credit given
	Unclear
	Repeat
	Benefit of doubt
	Cross
	Development

Question		Answer	Mark	Guidance						
1	(a)	<table border="1"> <thead> <tr> <th>Symbol</th> <th>Component</th> </tr> </thead> <tbody> <tr> <td></td> <td>Bell</td> </tr> <tr> <td></td> <td>Buzzer</td> </tr> </tbody> </table>	Symbol	Component		Bell		Buzzer	[2]	Award 1 mark for each correct response.
Symbol	Component									
	Bell									
	Buzzer									
	(b)	Electro Motive Force	[1]	Accept precise wording only.						
	(c)	$R = V/I$ $= 2/0.2$ $= 10 \Omega$	[2]	Award 1 mark for $R = V/I$ or $2/0.2$. Award 1 mark for 10Ω or 10. Award 2 marks if the correct answer without workings is seen with or without units.						
	(d)	<ul style="list-style-type: none"> • Sustainable for energy consumption • Indefinitely renewable (at least until the sun runs out in billions of years) • Relatively simple technology/Low maintenance costs • Clean, causes no pollution and silent producer of energy • Helps to slow/stop global warming • Can be used in remote areas • Decreases carbon footprints • Gives energy reliability, security and independence • Environmentally friendly • An efficient system 	[3]	Award 1 mark for each correct response. 3 x 1 marks. Accept other correct responses.						
	(e)	<ul style="list-style-type: none"> • Cheap in the long run as they can be re-used i.e. low cost/performance ratio. • Output stays constant until almost flat. • Disposal of fewer batteries creates less chemical pollution. 	[2]	Award 1 mark for each correct response. 2 x 1 marks. Accept other correct responses.						
		Total	[10]							

Question		Answer	Mark	Guidance
2	(a)	The missing values are 15, 33 and 68.	[1]	Award one mark for three correct values.
	(b)	Resistor value = $120 \Omega \pm 10\%$. 10% of 120 = 12 Maximum value = $120 + 12 = 132 \Omega$ Minimum value = $120 - 12 = 108 \Omega$	[3]	Award 1 mark for 12. Award 1 mark for 132Ω or 132. Award 1 mark for 108Ω or 108. Award 3 marks if the correct answers without workings are seen with or without units..
	(c) (i)	 <p>A Darlington pair is an arrangement of two bipolar transistors, either integrated or separated devices, connected in such a way that the current amplified by the first transistor is further amplified by the second transistor. A much higher current gain is achieved than using individual transistors. Overall gain is the product of the two individual gains.</p>	[4]	Award 1 mark for each correctly positioned transistor and correct labels. (Diagram). Award 1 mark for reference to two bipolar transistors. Award 1 mark for reference to current amplified or switch. Award 1 mark for reference to a much higher <u>current gain</u> is achieved than using individual transistors.
	(c) (ii)	Circuits Heat operated switch Low temperature alarm Amplifier Light from darkness Liquid level sensor	[2]	Award 1 mark for each correct response. 2 x 1 marks. Accept other correct responses.
Total			[10]	

Question		Answer	Mark	Guidance
3	(a)	<p>A latching switch is a <u>switch</u> that maintains its state after being activated.</p> <p>A push-to-make, push-to-break switch is a latching switch - each time you actuate it, whichever state the switch is left in will continue until the switch is actuated again.</p> <p>An example could be an alarm system.</p> <p>Once alarms are triggered, they remain on indefinitely, until the whole system is disabled. This is the case for most alarms, including burglar alarms and fire alarms.</p>	[2]	<p>Award 1 mark for reference to a <u>switch</u> that maintains its state after being activated.</p> <p>Award 1 mark for a correct application.</p>
	(b)		[5]	<ul style="list-style-type: none"> • DPDT switch symbol, [1] • connections from the supply +V and 0V to each common terminal of the DPDT switch [1] • NC switch 1 connected to NO switch 2 [1] • NC switch 2 connected to NO switch 1 [1] • connections from the DPDT switch to the motor [1]
	(c) (i)	A <u>shape memory alloy</u> is a material that can remember its original shape.	[1]	Award 1 mark for reference to 'can remember its original shape'. or 'return to its original shape'.
	(ii)	Copper-aluminium-nickel. Nickel-titanium (NiTi) alloys. Nitinol	[2]	<p>Award 1 mark for each correct response. 2 x 1 marks.</p> <p>Accept other correct responses.</p>
Total			[10]	

Question			Answer	Mark	Guidance																																																						
4	(a)	(i)	NOT gate, AND gate and OR gate.	[3]	Award 1 mark for each correct response.																																																						
		(ii)	<table border="1"> <thead> <tr> <th>Input A</th> <th>Input B</th> <th>Input C</th> <th>D</th> <th>E</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> <td>1</td> <td>0</td> <td>1</td> </tr> <tr> <td>0</td> <td>0</td> <td>1</td> <td>1</td> <td>0</td> <td>1</td> </tr> <tr> <td>0</td> <td>1</td> <td>0</td> <td>1</td> <td>0</td> <td>1</td> </tr> <tr> <td>0</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> </tr> <tr> <td>1</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>0</td> <td>1</td> <td>1</td> </tr> </tbody> </table>	Input A	Input B	Input C	D	E	Z	0	0	0	1	0	1	0	0	1	1	0	1	0	1	0	1	0	1	0	1	1	1	1	1	1	0	0	0	0	0	1	0	1	0	0	0	1	1	0	0	0	0	1	1	1	0	1	1	[3]	<p>Award 1 mark for column D.</p> <p>Award 1 mark for column E.</p> <p>Award 1 mark for Output Z.</p>
Input A	Input B	Input C	D	E	Z																																																						
0	0	0	1	0	1																																																						
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	(b)		<p>Examples of faults:</p> <ul style="list-style-type: none"> • Fitting of incorrect components • Incorrectly placed components • Missing components • Badly soldered joints • Dry joints • Bridged PCB tracks • Damaged PCB tracks • Short circuits • Open circuits 	[4]	<p>Award 1 mark for each correct response.</p> <p>4 x 1 marks</p>																																																						
			Total	[10]																																																							

Question		Answer	Mark	Guidance
5	(a)	<ul style="list-style-type: none"> • Surface-mount technology (SMT) is a method for producing electronic circuits. • The components are mounted or placed directly onto the surface of printed circuit boards. • SMT components are smaller than through hole components. 	[2]	Award 1 mark for each relevant point. 2 x 1 marks.
	(b)	<p>Benefits</p> <ul style="list-style-type: none"> • Fewer holes need to be drilled onto the circuit board • Costs and budgets are reduced as the parts often cost less than their equivalent through-hole parts. • Components can be placed on either side of the circuit boards. • Better mechanical performance under shake and vibration conditions. • The components of SMT are smaller. <p>Drawbacks</p> <ul style="list-style-type: none"> • The manufacturing process for SMT however, requires positioning of parts of un-perforated boards instead of accurate drilling of many holes. • Large, high-power or high-voltage parts are unsuitable for SMT. • This requires the process of combining SMT and through hole construction. • Manual prototype or component level repair is more difficult. • Skilled operators are needed with expensive tools as the parts are much smaller. • SMT is unsuitable as the sole attachment method for components that are subject to frequent mechanical stress. 	[6]	Award 1 mark for each correct benefit. 3 x 1 marks. Award 1 mark for each correct drawback. 3 x 1 marks

Question		Answer	Mark	Guidance										
	(c)	<table border="1"> <thead> <tr> <th>Quality Assurance Method</th> <th>tick (✓)</th> </tr> </thead> <tbody> <tr> <td>Half split method</td> <td></td> </tr> <tr> <td>Visual Inspection</td> <td>✓</td> </tr> <tr> <td>Automatic test</td> <td>✓</td> </tr> <tr> <td>Truth table test</td> <td></td> </tr> </tbody> </table>	Quality Assurance Method	tick (✓)	Half split method		Visual Inspection	✓	Automatic test	✓	Truth table test		[2]	Award zero marks if there are more than two (✓). Award 1 mark for each correct (✓). 2 x 1 marks.
Quality Assurance Method	tick (✓)													
Half split method														
Visual Inspection	✓													
Automatic test	✓													
Truth table test														
		Total	[10]											

Question			Answer	Mark	Guidance
6	(a)	(i)	$P = I^2R = 2^2 \times 0.05 = 0.2 \text{ W}$	[3]	Award 1 mark for $P = I^2R$ or $2^2 \times 0.05$. Award 1 mark for 0.2. Award 1 mark for correct unit W. Award 3 marks if the correct answer is seen without workings with or without units.
		(ii)	$W = Pt = 0.2 \times 3 = 0.6 \text{ Wh}$	[1]	Accept error carried forward from 6 (a) (i). Award 1 mark for numerical value and the unit Wh.

Question	Answer	Mark	Guidance/Level of response
6 (b)*	<p>The following statements could form the basis of a discussion.</p> <p>Solid core cables</p> <ul style="list-style-type: none"> • Single solid core ideal for plate-wiring (running wires across a chassis with all wires straight or at right-angles to one another) because wire stays exactly in formed shape without ties. • Solid wire is the wire of choice for outdoor or rugged-duty applications which may expose the wire to corrosive elements, adverse weather condition or frequent movement. • Solid wire cables are helpful in certain situations, such as wiring breadboards. One of the reasons that some choose to use single core in certain applications is that the cost is lower than that of the braided and stranded wire. • A solid core cable is not very flexible but one of its benefits is that it tends to be more rugged and durable so it is useful for locations where the environment or corrosion could cause damage to the wiring. <p>Multi-core cables.</p> <ul style="list-style-type: none"> • Multi-core cables are versatile and are used for all kind of applications, especially those which would otherwise call for a high volume of cables. • Multi-core cables are often used in electronic equipment and for applications where space is limited, such as aircraft and medical equipment. • Multi-core cables are used extensively in entertainment, with concert venues and theatres often utilising cables combining power to avoid a tangled mass of cables running across the stage. • Multi-core cables often split off at the end to form a mass of different connectors. This design is often referred to as a 'snake cable'. 	[6]	<p>Level 3 (5–6 marks)</p> <ul style="list-style-type: none"> • Detailed discussion showing a thorough understanding of the applications of solid core cables, multi-core cables and ribbon cables. • Information is presented clearly and accurately, with correct use of appropriate technical language and engineering terminology. • Acc urate use of spelling, punctuation and grammar. <p>Level 2 (3–4 marks)</p> <p>Adequate discussion showing some understanding of the applications of solid core cables, multi-core cables and ribbon cables.</p> <ul style="list-style-type: none"> • Information is presented clearly and with some accuracy. • Appropriate technical language and engineering terminology is used on some occasions. • Occasional errors in spelling, punctuation and grammar. <p>Level 1 (1–2 marks)</p> <ul style="list-style-type: none"> • Basic discussion showing limited understanding of the applications of solid core cables, multi-core cables and ribbon cables. • Information presented is basic and may be ambiguous or badly presented. • There will be little or no use of technical language and engineering terminology. • Errors of spelling, punctuation and grammar may be intrusive.

Question	Answer	Mark	Guidance
	<ul style="list-style-type: none"> • The term snake cable is frequently used in the professional audio recording industry to refer to an audio multi-core cable. Multi-core cables are used with professional video cameras. In television studios, 26-pin cables are used to connect "cameras" to camera control units. • Outside of media uses, multi-core cable is found in many places. Apartment buildings will often have multi-core coaxial cables that deliver cable television to the apartments. These cables often lead to a single floor or subsection and every hook-up in that area runs through the same multi-core cable. • Buildings will sometimes bundle other cables as well, depending on use and load. This same process is common in city infrastructure where power, coaxial and telephone cables are placed together into a single main line. <p>Ribbon Cable</p> <ul style="list-style-type: none"> • Ribbon cables are usually used as interconnects for internal peripherals in computers, such as hard drives, CD drives, and floppy drives. • Ribbon cables are also commonly used as internal wiring for other electronics and appliances. • They can be found in test and measuring equipment, automated termination equipment, robotics, and pick and place equipment. <p>Accept other correct discussion points.</p>		<p>Level 0 (0 marks)</p> <ul style="list-style-type: none"> • A response that is irrelevant and/or not worthy of a mark. • Annotate with 'Seen' at end of response. <p>NB. Award up to a maximum of 2 marks for each type of cable</p>
	Total	[10]	

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