



Cambridge National

Engineering

Unit **R113**: Electronic principles

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

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.



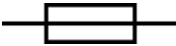
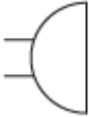
All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

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

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Annotations

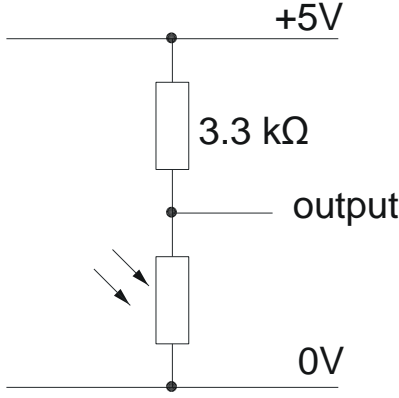
Annotation	Meaning
	Blank page
	Vague
	Tick
	Noted but no credit given
	Repeat
	Knowledge
	Example/Reference
	Development
	Cross
	Benefit of doubt
	Unclear
	Level 3
	Level 2
	Level 1

Question		Answer	Mark	Guidance
1	(a)	<p>AND Gate</p>  <p>Capacitor</p>  <p>Fuse</p>  <p>Buzzer</p> 		Award one mark for each correct graphical symbol.
1	(b)	$I = V/R$ $= 2/100$ $= 0.02 \text{ A}$	3	<p>Award one mark for $I = V/R$.</p> <p>Award one mark for 2/100.</p> <p>Award one mark for 0.02.</p> <p>Award three marks for 0.02 or 0.02 A without any workings.</p>
1	(c)	$P = I^2R$ $= 2^2 \times 220$ $= 880 \text{ W}$	3	<p>Award one mark for $P = I^2R$.</p> <p>Award one mark for $2^2 \times 220$.</p> <p>Award one mark for 880.</p> <p>Award three marks for 880 or 880 W without any workings.</p> <p>Accept any alternative correct method of solution</p>
Total			10	

Question		Answer	Mark	Guidance																									
2	(a)	<table border="1"> <thead> <tr> <th>Component</th> <th>Output device</th> </tr> </thead> <tbody> <tr> <td>Solenoid</td> <td>✓</td> </tr> <tr> <td>Liquid Crystal Display module</td> <td>✓</td> </tr> <tr> <td>Microphone</td> <td></td> </tr> <tr> <td>Piezo-electric buzzer</td> <td>✓</td> </tr> <tr> <td>Pressure switch</td> <td></td> </tr> <tr> <td>Seven Segment display</td> <td>✓</td> </tr> <tr> <td>NCT thermistor</td> <td></td> </tr> </tbody> </table>	Component	Output device	Solenoid	✓	Liquid Crystal Display module	✓	Microphone		Piezo-electric buzzer	✓	Pressure switch		Seven Segment display	✓	NCT thermistor		4	<p>Award zero marks if more than four boxes are ticked</p> <p>If four boxes are ticked award one mark for each correct response.</p>									
Component	Output device																												
Solenoid	✓																												
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2	(b)	$f = 1 / (1.38 RC)$. $R = 110 \text{ k}\Omega = 110 \times 10^3 \Omega$ $C = 3.3 \mu\text{F} = 3.3 \times 10^{-6} \text{F}$ $f = 1 / (1.38 \times 110 \times 10^3 \times 3.3 \times 10^{-6})$ $= 2 \text{ Hz}$	3	<p>Award one mark for $R = 110 \text{ k}\Omega = 110 \times 10^3 \Omega$.</p> <p>Award one mark for $C = 3.3 \mu\text{F} = 3.3 \times 10^{-6} \text{F}$.</p> <p>Award one mark for $f = 1 / (1.38 \times 110 \times 10^3 \times 3.3 \times 10^{-6}) = 2$ or 2 Hz.</p> <p>Award three marks for 2 or 2 Hz without any workings.</p>																									
2	(c)	<table border="1"> <thead> <tr> <th>Input A</th> <th>Input B</th> <th>OR gate output</th> <th>AND gate output</th> <th>NAND gate output</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>1</td> </tr> <tr> <td>0</td> <td>1</td> <td>1</td> <td>0</td> <td>1</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> <td>0</td> <td>1</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>0</td> </tr> </tbody> </table>	Input A	Input B	OR gate output	AND gate output	NAND gate output	0	0	0	0	1	0	1	1	0	1	1	0	1	0	1	1	1	1	1	0	3	<p>Award one mark for each correct column.</p>
Input A	Input B	OR gate output	AND gate output	NAND gate output																									
0	0	0	0	1																									
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1	1	1	1	0																									
Total			10																										

Question			Answer	Mark	Guidance																
3	(a)	(i)	The flow solder process is a bulk soldering process (1) used in the manufacture of printed circuit boards. (1) OR The circuit is passed over a pan of molten solder. A pump produces an upwelling of solder that looks like a standing wave. As the circuit board makes contact with this wave, the components become soldered to the circuit board.	2	Award one mark for each correct point made up to a maximum of two marks																
3	(a)	(ii)	A pick-and-place machine picks and places electronic components (1) onto the PCB prior to soldering. (1) OR Pick-and-Place machines use vacuum pickup tools to hold the components. In general, pick-and-place machines offer better speed, accuracy, and flexibility than through-hole insertion machines. Some of these machines cut and form the leads of the IC package at the time of placement in order to avoid component lead damage due to mishandling.	2	Award one mark for each correct point made up to a maximum of two marks																
3	(b)		<table border="1"> <thead> <tr> <th>Sequence of events</th> <th>Activity</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Apply flux to all pads on the circuit board.</td> </tr> <tr> <td>2</td> <td>The resistor should now be fastened on one side; apply solder to the soldering tip again and touch the iron tip on the other side.</td> </tr> <tr> <td>3</td> <td><i>Check that the tip of the soldering iron and the resistor are clean.</i></td> </tr> <tr> <td>4</td> <td>Inspect the solder joints with a magnifying glass to make sure the connection is good.</td> </tr> <tr> <td>5</td> <td>Place the resistor in position and hold it there with a pair of tweezers.</td> </tr> <tr> <td>6</td> <td>Touch the soldering tip so that it heats both the resistor and circuit board pad.</td> </tr> <tr> <td>7</td> <td>Apply some solder to the tip of the iron and touch the circuit board pad with the tip so that some of the solder passes on to the pad.</td> </tr> </tbody> </table>	Sequence of events	Activity	1	Apply flux to all pads on the circuit board.	2	The resistor should now be fastened on one side; apply solder to the soldering tip again and touch the iron tip on the other side.	3	<i>Check that the tip of the soldering iron and the resistor are clean.</i>	4	Inspect the solder joints with a magnifying glass to make sure the connection is good.	5	Place the resistor in position and hold it there with a pair of tweezers.	6	Touch the soldering tip so that it heats both the resistor and circuit board pad.	7	Apply some solder to the tip of the iron and touch the circuit board pad with the tip so that some of the solder passes on to the pad.	6	Award one mark for each correct line 2/3/4/5/6/7. Event 1 is given in the question.
Sequence of events	Activity																				
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Total				10																	

Question		Marks	Mark	Answer
4	(a)*	<p>Level 3 (5–6 marks)</p> <ul style="list-style-type: none"> Detailed discussion showing a thorough understanding of the function and applications of an LDR and an LED in electronic circuits. Information is presented clearly and accurately, with correct use of appropriate technical language and engineering terminology. Accurate use of spelling, punctuation and grammar. <p>Level 2 (3–4 marks)</p> <ul style="list-style-type: none"> Adequate discussion showing some understanding of the function and applications of an LDR and an LED in electronic circuits. 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 mark)</p> <ul style="list-style-type: none"> Basic discussion showing limited understanding of the function and applications of an LDR and an LED in electronic circuits. 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. <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. 	6	<p>LDR – Input device When light falls on an LDR the resistance is low. (1) When an LDR is kept in the dark, its resistance is high.(1) <u>Application (1)</u> Light sensor, Burglar alarm circuits Alarm clock Light intensity meters, Street light control Automatic Headlight Dimmer Night Light Control Absence / Presence (beam breaker) Position Sensor Camera Exposure Control Auto Slide Focus - dual cell Photocopy Machines – toner density</p> <p>LED – Output device A light-emitting diode is a semiconductor device that emits visible light (1) when an electric current passes through it.(1) <u>Application (1)</u> Digital clocks, video recorders and microwave ovens. Indicator lights: bar-graph, or alphabetic-numeric readouts. LCD panel backlighting: Specialized white LEDs are used in flat-panel computer displays. Fibre optic data transmission Remote control Keyboard for Num lock, Caps lock and Scroll Lock</p>

Question		Answer	Mark	Guidance
4	(b)		4	<p>Award one mark for correct LDR symbol (with or without envelope) and position.</p> <p>Award one mark for correct resistor symbol and position.</p> <p>Award one mark for correct 0 – 5V input supply position.</p> <p>Award one mark for correct output voltage position.</p>
Total			10	

Question			Answer	Mark	
5	(a)			3	<p>Award one mark for correct symbol and position of ammeter.</p> <p>Award one mark for correct symbol and position of voltmeter across one lamp.</p> <p>Award one mark for correct symbol and position of voltmeter across the switch and the cell to measure e.m.f. OR award one mark for correct symbol and position of voltmeter across the cell to measure e.m.f.</p>
5	(b)	(i)	Single Pole Single Throw (SPST)	1	Correct answer only.
5	(b)	(ii)	Signal	1	Correct answer only.
5	(c)	(i)	$R = 1.8 + 1.8 + 1.8$ $= 5.4 \Omega$	2	<p>Award one mark for $R = 1.8 + 1.8 + 1.8$.</p> <p>Award one mark for 5.4 or 5.4Ω.</p> <p>Award two marks for 5.4 or 5.4Ω without any workings.</p>
5	(c)	(ii)	$W = Pt = 10 \times 4 = 40 \text{ Wh} = 0.04 \text{ kWh}$ <p>OR</p> $W = Pt = 10 \times 4 \times 60 \times 60 = 144000 \text{ Ws or } 144000 \text{ J}$	3	<p>Award one mark for $W = Pt$.</p> <p>Award one mark for workings.</p> <p>Award one mark for correct answer with correct unit.</p> <p>Award three marks for correct answer with correct unit with or without workings.</p>
Total				10	

Question			Answer	Mark	Guidance
6	(a)		Visual inspection (includes checking) of equipment Portable appliance testing (PAT) compliance Use of residual current device (RCD)	3	Award one mark for each correct response.
6	(b)		Tests can determine whether or not the circuit is fit for purpose. Circuit can be modified and retested quicker than a real circuit. Helps circuit designers test ideas before actually building real circuits, saving much time and money. Relatively simple to use. Simulation can be saved	2	Accept any two correct reasons. Accept other correct reasons.
6	(c)	(i)	A Square wave (accept astable) B Sine wave (accept alternating) C Triangular wave (accept saw tooth)	3	Award one mark for each correct response.
6	(c)	(ii)	D To control amplitude E Frequency multiplier or wavelength multiplier	2	Award one mark for each correct response. Accept alternative correct answers.
Total				10	

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