



Oxford Cambridge and RSA

Cambridge National

Engineering

R113/01: Systems Control in Engineering: Electronic principles

Level 1/2 Cambridge National Certificate/Award

Mark Scheme for January 2023

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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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PREPARATION FOR MARKING

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking.
2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are posted on the RM Cambridge Assessment Support Portal <http://www.rm.com/support/ca>

MARKING

1. Mark strictly to the mark scheme. Marks awarded must relate directly to the marking criteria.
2. The schedule of dates is very important. It is essential that you meet the 50% and 100% (traditional 40% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.
3. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone or the messaging system, or by email.
4. **Crossed Out Responses**

Where a candidate has crossed out a response and provided a clear alternative then the crossed out response is not marked. Where no alternative response has been provided, examiners may give candidates the benefit of the doubt and mark the crossed out response where legible.

Contradictory Responses

When a candidate provides contradictory responses, then no mark should be awarded, even if one of the answers is correct.

Short Answer Questions (requiring only a list by way of a response, usually worth only **one mark per response**)

Where candidates are required to provide a set number of short answer responses then only the set number of responses should be marked. The response space should be marked from left to right on each line and then line by line until the required number of responses have been considered. The remaining responses should not then be marked. Examiners will have to apply judgement as to whether a 'second response' on a line is a development of the 'first response', rather than a separate, discrete response. (*The underlying assumption is that the candidate is attempting to hedge their bets and therefore getting undue benefit rather than engaging with the question and giving the most relevant/correct responses.*)

Short Answer Questions (requiring a more developed response, worth **two or more marks**) If the candidates are required to provide a description of, say, three items or factors and four items or factors are provided, then mark on a similar basis – that is downwards (as it is unlikely in this situation that a candidate will provide more than one response in each section of the response space.)














Longer Answer Questions (requiring a developed response)

Where candidates have provided two (or more) responses to a medium or high tariff question which only required a single (developed) response and not crossed out the first response, then only the first response should be marked. Examiners will need to apply professional judgement as to whether the second (or a subsequent) response is a 'new start' or simply a poorly expressed continuation of the first response.

5. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there then add a tick to confirm that the work has been seen.
6. There is a NR (No Response) option. Award NR (No Response)
 - if there is nothing written at all in the answer space
 - OR if there is a comment which does not in anyway relate to the question (e.g. 'can't do', 'don't know')
 - OR if there is a mark (e.g. a dash, a question mark) which isn't an attempt at the question
 Note: Award 0 marks - for an attempt that earns no credit (including copying out the question)
7. The **comments box** is used by your team leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.** If you have any questions or comments for your team leader, use the phone or e-mail.
8. Assistant Examiners will send a brief report on the performance of candidates to your Team Leader (Supervisor) by the end of the marking period. The Assistant Examiner's Report Form (AERF) can be found on the RM Cambridge Assessment Support Portal (and for traditional marking it is in the *Instructions for Examiners*). Your report should contain notes on particular strength displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.
9. For answers marked by levels of response:
 - a. **To determine the level** – start at the highest level and work down until you reach the level that matches the answer
 - b. **To determine the mark within the level**, consider the following:

Descriptor	Award mark
On the borderline of this level and the one below	At bottom of level
Just enough achievement on balance for this level	Above bottom and either below middle or at middle of level (depending on number of marks available)
Meets the criteria but with some slight inconsistency	Above middle and either below top of level or at middle of level (depending on number of marks available)
Consistently meets the criteria for this level	At top of level

10 Annotations

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

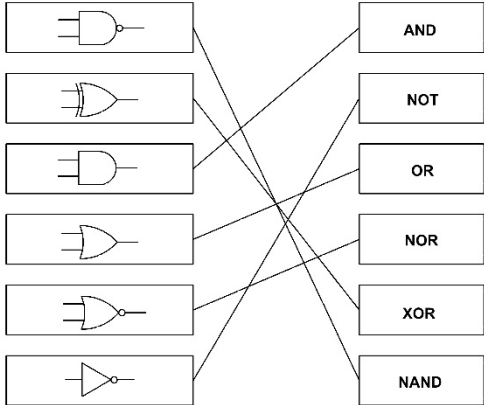
Question		Answer	Mark	Guidance
1	(a)		<p>LED - Award one mark for correct symbol and one mark for cathode connected to Tr1</p> <p>Resistor - Award one mark for correct symbol and one mark for correct position.</p> <p>Award one mark for 0 V correct position and one mark for +9 V correct position.</p>	<p>6</p> <p>Accept the LED symbol without the circle.</p> <p>Labels can be either end of rails</p>
1	(b)	Throw [1]	1	
1	(c)	<p>Total resistance (R) = 10 + 10 + 10 [1]</p> <p>= 30 [1] Ω [1]</p>	3	<p>Award 3 marks for correct value with no working.</p> <p>Accept 30 or 30 Ω.</p>
Total			10	

2	(a)		<p>The polarized capacitor will have legs of different lengths (1) whereas the non-polarized capacitor will have legs of the same length [1]. The polarized capacitor will have a '+' or a '-' printed on it and can only be connected one way round in a circuit. [1] The value of a polarised capacitor is likely to be much greater than a non-polarised one. [1] The non-polarised capacitor can be connected either way round in a circuit [1].</p> <p>2 x 1 marks</p>	2	
2	(b)	(i)	<p>Red indicates 2. [1] Brown indicates 1. [1] Orange indicates 000 or 1000. [1] <i>Gold already completed</i> 21000 pF \pm 5%. [1]</p>	4	
2	(b)	(ii)	<p>Minimum value = $200 - (5\% \text{ of } 200)$ [1] = 190 pF. [1] Maximum value = $200 + (5\% \text{ of } 200)$ [1] = 210 pF. [1] 2 x 2 marks</p>	4	Award marks for a correct answer with no working
			Total	10	

3	(a)		Closed loop. [1]	1	
3	(b)	(i)	Input When a system is receiving a command or signal from outer sources, the event is referred to as an input. [1] i.e. generates the signal to the processor block.	6	Accept any variations that demonstrate understanding (including examples)
		(ii)	Output Any information that is processed by and sent out from a system is an output. [1] i.e. generates a signal that is sent out.		
		(iii)	Processor A processor is a unit that controls the ability to monitor [1] and adjust a process to give a desired output.[1] Takes the signal from the input and decides on the output.		
		(iv)	Feedback That portion of the output of a system that is returned to modify the input [1] and therefore serves as a performance monitor for the system. [1]		
3	(c)		$V = IR$ [1] $= 0.3 \times 40$ [1] $= 12 V$ [1]	3	Award 3 marks for correct answer with no working. Allow either 12 or 12 V
			Total	10	

4	(a)*	<p>Level 3 (5–6 marks)</p> <ul style="list-style-type: none"> Detailed discussion showing a thorough understanding of the two techniques used to identify potential electrical hazards 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 two techniques used to identify potential electrical hazards 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 two techniques used to identify potential electrical hazards in electronic circuits. Information is presented inadequately with some inaccuracies. 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>Portable appliance testing (PAT) compliance is the name of a process by which appliances are routinely checked for safety. The formal term for the process is "in-service inspection & testing of electrical equipment"</p> <p>A full PAT test includes a visual inspection of the appliance and an in-depth check using special PAT testing equipment. This test checks earth continuity, lead polarity, and insulation resistance of the appliance.</p> <p>A residual current safety device (RCD) is a sensitive safety device that switches off electrical current automatically if there is a fault. It is a life-saving device which is designed to prevent persons from getting a fatal electric shock if you touch anything live, such as a bare wire and it can also provide some protection against electrical fires. An RCD can interrupt the current even if the other devices have failed. RCD monitors imbalance in the supply currents (live) and return (Neutral) conductors of a circuit – looking for a difference of over 30 mA.</p> <p>Award a maximum of three marks for PAT and a maximum of three marks for RCD.</p>

4	(b)		Electrical test equipment: <ul style="list-style-type: none">• Power supply unit• Ammeter• Voltmeter• Wattmeter• Ohmmeter• Multimeter• Logic probe• Signal generator• Oscilloscope• PAT• RCD tester 4 x 1 marks	4	
			Total	10	

5	(a)			5	<p>Award 1 mark for each correct line up to 4 lines.</p> <p>Either 5 or 6 lines correct gains 5 marks</p>																																										
		5	(b)			<table border="1" data-bbox="376 906 1541 1193"> <thead> <tr> <th>Input A</th> <th>Input B</th> <th>AND gate output</th> <th>OR gate output</th> <th>NOR gate output</th> <th>XOR 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> <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> <td>1</td> </tr> <tr> <td>1</td> <td>0</td> <td>0</td> <td>1</td> <td>0</td> <td>1</td> <td>1</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td></td> <td></td> <td>[1]</td> <td>[1]</td> <td>[1]</td> <td>[1]</td> <td>[1]</td> </tr> </tbody> </table>	Input A	Input B	AND gate output	OR gate output	NOR gate output	XOR gate output	NAND gate output	0	0	0	0	1	0	1	0	1	0	1	0	1	1	1	0	0	1	0	1	1	1	1	1	1	0	0	0			[1]	[1]	[1]	[1]
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		[1]	[1]	[1]	[1]	[1]																																									
Total			10																																												

6	(a)		Flow wave solder process [1] Manual component placement [1] Pick and place robot [1]	3	Accept: wave soldering flow soldering reflow soldering through hole technology
6	(b)		Faults: <ul style="list-style-type: none"> • Missing component • Incorrect component • Incorrect orientation • Damaged component • Incorrectly soldered component • Overheated or burnt component • Cracked PCB • Broken connections/tracks • Dirt or corroded pins • Water or foreign matter on PCB • Damaged wiring <p>[1] mark x 5</p>	5	Accept any other correct responses.
6	(c)		The missing values are: 10 [1] 39 [1]	2	
			Total	10	

Turn over

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