



GCSE MARKING SCHEME

AUTUMN 2020

**GCSE
ELECTRONICS – COMPONENT 1
C490UA0-1**

INTRODUCTION

This marking scheme was used by WJEC for the 2020 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conference, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

GCSE ELECTRONICS
AUTUMN 2020 MARK SCHEME
COMPONENT 1 – DISCOVERING ELECTRONICS

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (except for the extended response question).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

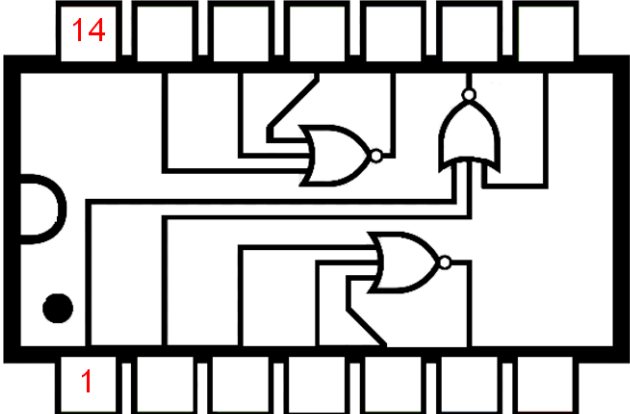
Extended response question

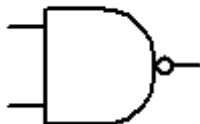
A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statement.

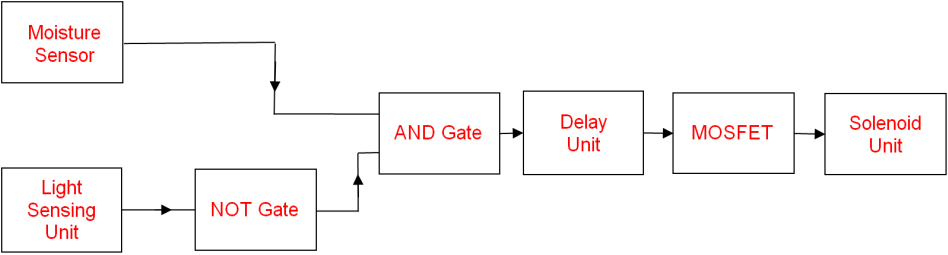
Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao	=	correct answer only
ecf	=	error carried forward

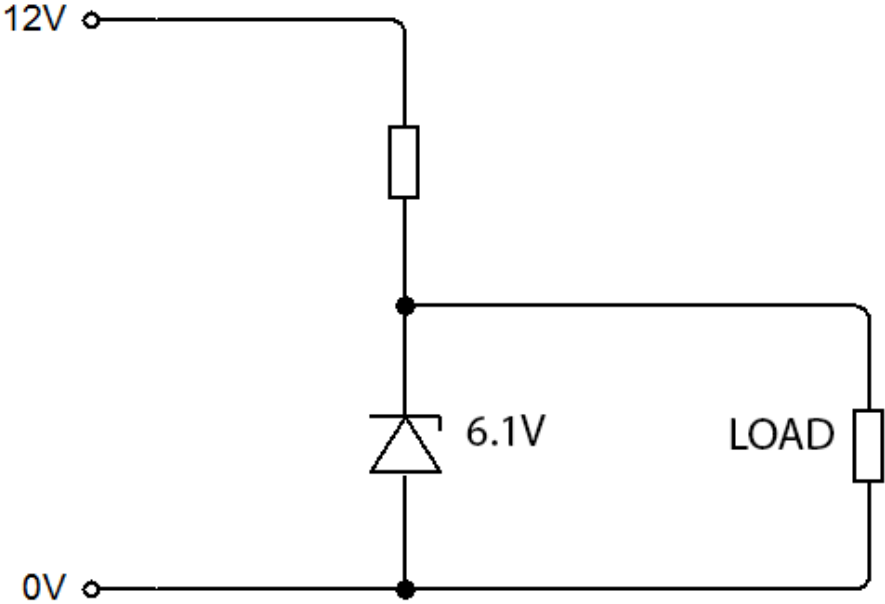
Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
1.	(a)	(i)	 Both Pins needed for mark	1				
		(ii)	9	1				
		(iii)	3	1				
		(iv)	NOR Gate	1				
	(b)	(i)		1				

Question			Marking details	Marks available																			
				AO1	AO2	AO3	Total	Maths															
		(ii)		1																			
	(c)	(i)	<table><tr><td>B</td><td>A</td><td>Q</td></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>0</td></tr><tr><td>1</td><td>0</td><td>0</td></tr><tr><td>1</td><td>1</td><td>1</td></tr></table>	B	A	Q	0	0	0	0	1	0	1	0	0	1	1	1	1				
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		(ii)	<table><tr><td>B</td><td>A</td><td>Q</td></tr><tr><td>0</td><td>0</td><td>1</td></tr><tr><td>0</td><td>1</td><td>0</td></tr><tr><td>1</td><td>0</td><td>0</td></tr><tr><td>1</td><td>1</td><td>0</td></tr></table>	B	A	Q	0	0	1	0	1	0	1	0	0	1	1	0	1				
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Question 1 total				8	0	0	8	0															

Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
2.	(a)	(i)	Buzzer Unit – Output	1			1	
		(ii)	Switch Unit – Input	1			1	
		(iii)	Transistor Switch Unit – Process	1			1	
		(iv)	Comparator – Process	1			1	
	(b)		 1 mark for each correct box		2	5	7	
	(c)		Monostable	1			1	
Question 2 total				5	2	5	12	0

Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
3.	(a)		Circuit B	1			1	
	(b)	(i)	$V_1 = 9 - 3 = 6V$ $I_1 = 25 - 10 = 15mA$ $V_2 = 3V$ $I_2 = 25mA$	1	3		4	3
		(ii)	$V = IR$ $R_2 = \frac{V}{I} \quad (1 - \text{Rearranging})$ $R_2 = \frac{3}{10 \times 10^{-3}} \quad (1 - \text{Substitution})$ $R_2 = 300\Omega \quad (1 - \text{Answer})$	1	2		3	3
	(c)		Red (1) Yellow (1) Brown (1) Gold (1)	4			4	0
			Question 4 total	7	5	0	12	6

Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
4.	(a)		Adding resistor in parallel lowers the effective resistance of the parallel branch (1) A lower effective resistance in the parallel branch gives lower voltage across V_{OUT} (1) – or alternative e.g. resistance in parallel branch decreases causing increase in current, voltage across 200Ω resistor increases (1) therefore voltage across the parallel branch falls (1)	1	1	0	2	
	(b)		Effective Resistance of two 200Ω resistors in parallel = $200/2 = 100\Omega$ (1) Or $R_p = \frac{R_1 \times R_2}{R_1 + R_2} = \frac{200 \times 200}{200 + 200} = \frac{40000}{400} = 100\Omega$ $V_{OUT} = \frac{R_2}{R_1 + R_2} \times V_{IN} \dots \dots \dots (1 - Formula)$ $V_{OUT} = \frac{100}{200 + 100} \times 12 \dots \dots \dots (1 - Substitution)$ $V_{OUT} = \frac{100}{300} \times 12 = 4V \dots \dots \dots (1 - Answer)$	2	2		4	4

Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
	(c)		 12V 0V 6.1V LOAD Zener in series with resistor – (1) Correct orientation of Zener – (1)					
Question 4 total				5	3	0	8	4

Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
5.			Indicative Content: The circuit does not fully meet the specification. There are a number of issues with the design as it stands. The sensing circuit is connected to the correct input of the comparator. As the light intensity falls the resistance of the LDR increases and hence the voltage at the non inverting input rises which is the opposite of what is required and would close the blinds in the dark. It is configured the wrong way round. i.e. the LDR should be on the top and the resistor on the bottom. The specification states that the blinds should close when the light level is 400 lux. From the characteristic this shows that the resistance of the LDR is at 25kΩ at 400 lux. This means the voltage across the LDR would be 7.5V at 400 lux, whilst the reference voltage is at 4.5V so the blinds would have closed before the stated threshold of 400 lux. In order to meet the requirement of closing the blinds at 400 lux the LDR and resistor need to be switched and R1 needs to be increased to just over 25kΩ, or the combination of R3 / R4 are changed to provide just under 2.5V at the non-inverting input to the comparator. The simplest solution would be to make one of the fixed resistors variable and then the system becomes adjustable and can be adjusted to switch on at the correct light level.					

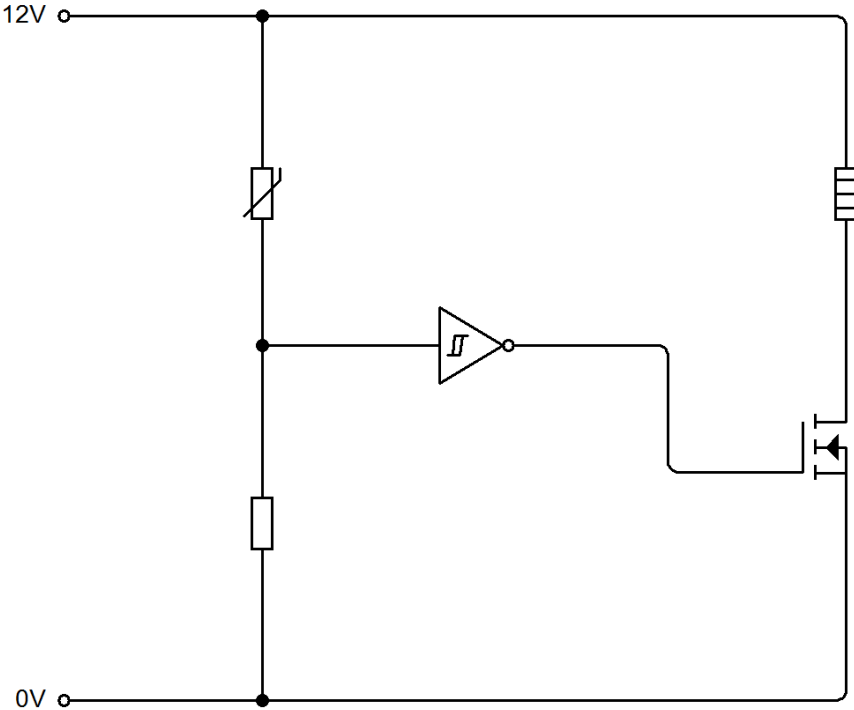
Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
			5-6 marks Recognition that the specification is not met with detailed analysis and description of all issues identified in the indicative content including modifications. <i>There is a sustained line of reasoning which is coherent, substantiated and logically structured. The information included in the response is relevant to the argument.</i> 3-4 marks Recognition that the specification is not met with some analysis and description of at least two issues identified in the indicative content and basic suggestion of required modifications. <i>There is a line of reasoning which is partially coherent, supported by some evidence and with some structure. Mainly relevant information is included in the response but there may be some minor errors or the inclusion of some information not relevant to the argument.</i> 1-2 marks Recognition that the specification is not met with minimal analysis and description of up to one issue identified in the indicative content with limited attempt at modifications to the circuit. <i>There is a basic line of reasoning which is not coherent, supported by limited evidence and with very little structure. There may be significant errors or the inclusion of information not relevant to the argument.</i> 0 marks No recognition that the specification is not met with no analysis or description of any issues identified in the indicative content.	0	1	5	6	
			Question 5 total	0	1	5	6	2

Question			Marking details				Marks available																																																										
							AO1	AO2	AO3	Total	Maths																																																						
6.	(a)	(i)	$D = \bar{A}$					1		1	1																																																						
		(ii)	$E = B.C$					1		1	1																																																						
		(iii)	$Q = \overline{\bar{A} + B.C}$ (Accept $A.(B.C)$ or $A.(\bar{B} + \bar{C})$ do not accept $Q = \bar{D} + \bar{E}$)					1		1	1																																																						
	(b)		<table><tr><th>C</th><th>B</th><th>A</th><th>D</th><th>E</th><th>Q</th></tr><tr><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td></tr><tr><td>0</td><td>0</td><td>1</td><td>0</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>0</td></tr><tr><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td></tr><tr><td>1</td><td>0</td><td>0</td><td>1</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>1</td></tr><tr><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td><td>0</td></tr><tr><td>1</td><td>1</td><td>1</td><td>0</td><td>1</td><td>0</td></tr></table>				C	B	A	D	E	Q	0	0	0	1	0	0	0	0	1	0	0	1	0	1	0	1	0	0	0	1	1	0	0	1	1	0	0	1	0	0	1	0	1	0	0	1	1	1	0	1	1	0	1	1	1	0	1	0		3		3	
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			1 mark per correct column – e.c.f. for Q if D or E incorrect.																																																														

Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
	(c)	(i)		3			3	
		(ii)		2	0		2	
Question 6 total				5	6	0	11	3

Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
7.		(i)	$V_{IN} = V_{2k} + V_{BE} \quad (1)$ $V_{2k} = V_{IN} - V_{BE} = 1.5 - 0.7 = 0.8V \quad (1)$	1	1		2	2
		(ii)	$V = IR$ $I_{2k} = \frac{V}{R} \quad (1 - \text{Rearranging})$ $I_{2k} = \frac{0.8}{2 \times 10^3} \quad (1 - \text{Substitution})$ $I_{2k} = 0.4 \text{ mA} \quad (1 - \text{Answer})$	1	2		3	3
		(iii)	$I_c = I_b h_{FE} \quad (1 - \text{formula})$ $I_c = 0.4 \times 10^{-3} \times 250 \quad (1 - \text{substitution})$ $I_c = 0.1A \quad (1 - \text{answer})$	1	2		3	3
		(iv)	$P = IV \quad (1 - \text{Formula})$ $P = 0.1 \times 9 \quad (1 - \text{Substitution})$ $P = 0.9W \quad (1 - \text{Answer})$	1	2		3	3
			Question 7 total	4	7	0	11	11

Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
8.			Raise Entrance Barrier - B Is count = 100? - C Issue ticket - A Count = count – 1 - E Is car present at exit? - D		5			
Question 8 total				0	5	0	5	0

Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
9.	(a)		$I_D = g_M(V_{GS} - 3) \text{ (1 - equation)}$ $I_D = 2.5(9 - 3) \text{ (1 - substitution)}$ $I_D = 15A \text{ (1 - answer)}$	1	2		3	3
	(b)	(i)	 Addition of Schmitt Inverter – (1) Reversal of sensing subsystem – (1)		2		2	

Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
		(ii)	The Schmitt trigger has two switching thresholds (1) therefore once activated the temperature level has to cause a significant change in voltage before the Schmitt will change to the opposite logic level. (1)	0	2		2	3
			Question 9 total	1	6	0	7	3
			TOTAL	35	35	10	80	29