



GCSE MARKING SCHEME

SUMMER 2022

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

INTRODUCTION

This marking scheme was used by WJEC for the 2022 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
SUMMER 2022 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.

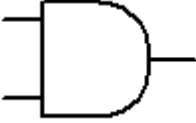
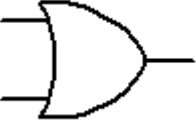
Extended response question

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)	 1 mark	1			1																										
		(ii)	 1 mark	1			1																										
	(b)	(i)	<table border="1" data-bbox="421 724 1420 943"> <thead> <tr> <th>B</th> <th>A</th> <th>X</th> <th>Y</th> <th>Q</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>1</td> <td>1</td> <td>0</td> </tr> <tr> <td>0</td> <td>1</td> <td>0</td> <td>1</td> <td>0</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> <td>0</td> <td>1</td> </tr> </tbody> </table> 1 mark for each correct output column. (allow e.c.f. for correct Q from incorrect X or Y)	B	A	X	Y	Q	0	0	1	1	0	0	1	0	1	0	1	0	1	0	0	1	1	0	0	1	0	3		3	
B	A	X	Y	Q																													
0	0	1	1	0																													
0	1	0	1	0																													
1	0	1	0	0																													
1	1	0	0	1																													
		(ii)	AND gate ecf (i)	1			1																										
	(c)		NAND gate	1			1																										

Question		Marking details		Marks available				
				AO1	AO2	AO3	Total	Maths
	(d)	$\overline{X + Y} = \overline{X} \cdot \overline{Y}$ <input type="checkbox"/> $\overline{X + Y} = \overline{X} \cdot \overline{Y}$ <input checked="" type="checkbox"/> 1 mark $\overline{X + Y} = \overline{X} + \overline{Y}$ <input type="checkbox"/> $\overline{X \cdot Y} = \overline{X} \cdot \overline{Y}$ <input type="checkbox"/> $\overline{X \cdot Y} = \overline{X} + \overline{Y}$ <input checked="" type="checkbox"/> 1 mark		2			2	
		Question 1 total		6	3	0	9	0

Question		Marking details	Marks available				
			AO1	AO2	AO3	Total	Maths
2.	(a)	<p>The diagram shows a logic circuit with two inputs, A and B. The circuit produces three outputs: X, Y, and Q. The implementation of X is shown in a red box, consisting of two NOT gates in series with an AND gate. The implementation of Y is shown in a red box, consisting of a single AND gate. The implementation of Q is shown in a red box, consisting of a single AND gate. An alternative implementation for X is shown in a green box, consisting of an OR gate followed by a NOT gate. The text 'X implementation = 1 Mark' is written in red below the first red box. The text 'Q implementation = 1 Mark' is written in red below the second red box. The text 'Q implementation = 1 Mark' is written in red below the third red box. The text 'Alternative X implementation = 1 Mark' is written in green below the green box.</p>			3	3	

Question		Marking details	Marks available				
			AO1	AO2	AO3	Total	Maths
(b)	(i)	<p>NOT Gate = 1 Mark</p> <p>AND Gate = 1 Mark</p> <p>NOR Gate = 1 Mark</p>	3			3	
	(ii)	<p>1st Pair = 1 Mark</p> <p>2nd Pair = 1 Mark</p> <p>ecf (i)</p>		2		2	

Question		Marking details	Marks available				
			AO1	AO2	AO3	Total	Maths
	(c)	<p>Either,</p> <p>i. To reduce the number of i.c. packages required – smaller footprint on circuit boards.</p> <p>Or,</p> <p>ii. To reduce the cost of projects as only one type of logic gates needs to be purchased.</p>			1	1	
		Question 2 total	3	2	4	9	0

Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
3.	(a)		Brown (1) Grey (1) Red (1) Gold (1)	4			4	0
	(b)	(i)	$V_1 = 12 - 3 (1) = 9V (1)$	1	1		2	1
		(ii)	$V = IR$ (1 – Formula) $I_1 = \frac{V}{R}$ (1 – Rearranging) $I_1 = \frac{9}{1.8 \times 10^3}$ (1 – Substitution) $I_1 = 5mA$ (1 – Answer)	1	3		4	4
		(iii)	$I_2 = I_1 - 2mA (1) = 5mA - 2mA = 3mA (1)$ ecf (ii)		2		2	1
	(c)		$V_2 = 3V (1)$	1			1	0
			Question 3 total	7	6	0	13	6

Question		Marking details	Marks available				
			AO1	AO2	AO3	Total	Maths
4.	(a)	<p>1 mark for each correct link</p>	5	0	0	5	

Question		Marking details	Marks available				
			AO1	AO2	AO3	Total	Maths
	(b)	<p>Indicative content:</p> <p>The circuit does not fully meet the specification. There are a number of issues with the design as it stands.</p> <p>The design correctly has two sensors one on each door. The delay unit however has been attached to the rear door instead of the front door. This will delay the start of the alarm when the rear door is opened instead of an immediate trigger. Also with no delay on the front door, the alarm would sound immediately. This contradicts the specification. The delay unit therefore needs to be moved to the front door instead of the back door. The pulse generator will produce a siren that switches on and off continuously. If the doors are closed after they are opened the alarm will stop sounding. The block diagram needs a latch to keep the alarm sounding once it has been triggered and to provide a method of resetting the alarm. The latch should be placed between the output of the OR gate and the input to the AND gate.</p> <p>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.</p> <p><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></p> <p>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.</p> <p><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></p>					

Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
			<p>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.</p> <p><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></p> <p>0 marks No recognition that the specification is not met with no analysis or description of any issues identified in the indicative content.</p> <p><i>Response not creditworthy or not attempted.</i></p>	0	1	5	6	
Question 4 total				5	1	5	11	0

Question		Marking details	Marks available				
			AO1	AO2	AO3	Total	Maths
5.	(a)	$V_{OUT(A)} = \frac{R_2}{R_1+R_2} \times V_{IN}$ ----- (Equation = 1)	1	2		3	3
		$V_{OUT(A)} = \frac{6.8}{6.2+6.8} \times 9$ ----- (Substitution = 1)					
		$V_{OUT(A)} = 4.707V \cong 4.7V$ ----- (Answer = 1)					
	(b)	$V_{OUT(B)} = 4.7V$	1			1	
	(c)	$R_{parallel} = \frac{R_1 \times R_2}{R_1 + R_2}$ ----- (Equation = 1)	2	4		6	5
		$R_{parallel} = \frac{6.8 \times 1}{6.8 + 1}$ ----- (Substitution = 1)					
		$R_{parallel} = 0.872k\Omega$ ----- (Answer = 1)					
		$V_{OUT(A)} = \frac{0.872}{6.2 + 0.872} \times 9$ ----- (Substitution = 1)					
		$V_{OUT(A)} = 1.109V \cong 1.11V$ ----- (Answer = 1)					
		$V_{OUT(B)} = 4.7V$ ----- (Answer = 1)					
	(d)	Circuit A – The output voltage falls – decreases	1		1	2	
		Circuit B – The output voltage is constant at 4.7V – stays the same					
		Question 5 total	5	6	1	12	8

Question		Marking details	Marks available				
			AO1	AO2	AO3	Total	Maths
6.	(a)	39kΩ (+/-1kΩ)		1		1	1
	(b)	$V_{OUT} = \frac{R_2}{R_1+R_2} \times V_{IN}$ ----- (Equation = 1) $V_1 = \frac{39}{13+39} \times 12$ ----- (Substitution = 1) $V_1 = 9V$ ----- (Answer = 1) ecf (a)	1	2		3	3
	(c)	Very slightly under 9.0 V, approx. 8.99V (-0.1V max) ecf (b)	1			1	
	(d)	$P = IV$ ----- (1 – Formula) $I = \frac{P}{V}$ ----- (1 – Rearrangement) $I = \frac{48}{12}$ ----- (1 – Substitution) $I = 4A$ ----- (1 – Answer)		4		4	4

Question		Marking details	Marks available				
			AO1	AO2	AO3	Total	Maths
	(e)	$I_D = g_M(V_{GS} - 3)$ ----- (1 – equation) $g_M = \frac{I_D}{(V_{GS}-3)}$ ----- (1 – rearrangement) $g_M = \frac{4}{(8-3)}$ ----- (1 – substitution) $g_M = \frac{4}{5} = 0.8S$ (1 - answer)	1	3		4	4
		Question 6 total	3	10	0	13	12

Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
7.	(a)		$P = IV$ (1- Formula) $P = 0.3 \times 12$ (1- Substitution) $P = 3.6W$ (1 – Answer)	1	2		3	3
	(b)	(i)	$I_C = I_B h_{FE}$ (1 - formula) $I_B = \frac{I_C}{h_{FE}}$ (1 – Rearranging) $I_B = \frac{0.3}{150}$ (1 – Substitution) $I_B = 2 \text{ mA}$ (1 – Answer)	1	3		4	4
		(ii)	$V = IR$ (1 – Formula) $V = 2\text{mA} \times 1.8\text{k}\Omega$ (1 – Substitution) $V = 3.6V$ (1 – Answer) ecf (i)	1	2		3	3
	(c)		$V_2 = 0.7V$	1			1	

Question		Marking details	Marks available				
			AO1	AO2	AO3	Total	Maths
	(d)	$V_1 = V_{1.8k} + V_{BE} \quad (1)$ $V_1 = 3.6 + 0.7 = 4.3V \quad (1)$ ecf (b) & (c)	2			2	2
		Question 7 total	6	7	0	13	12
		PAPER TOTAL	35	35	10	80	38