GCSE MARKING SCHEME

SUMMER 2023

GCSE
ELECTRONICS – COMPONENT 1
C490UA0-1

INTRODUCTION

This marking scheme was used by WJEC for the 2023 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

COMPONENT 1 – DISCOVERING ELECTRONICS

SUMMER 2023 MARK SCHEME

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.

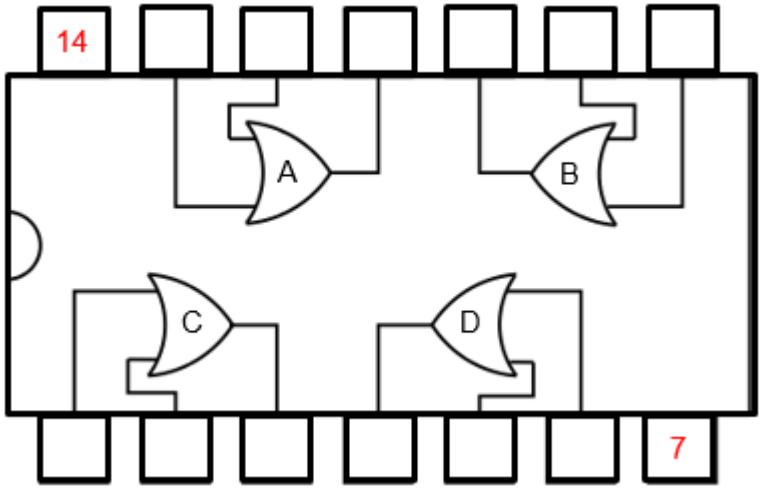
Extended response question

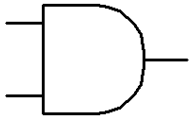
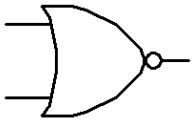
A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide 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.

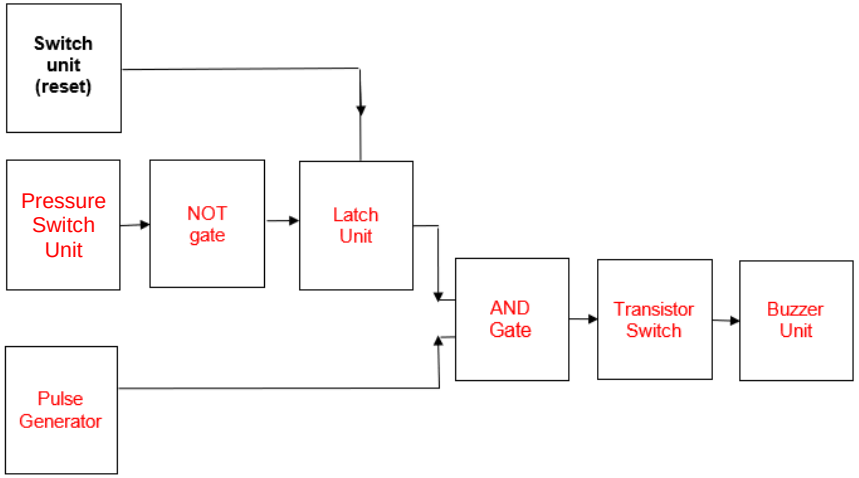
Marking abbreviations

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

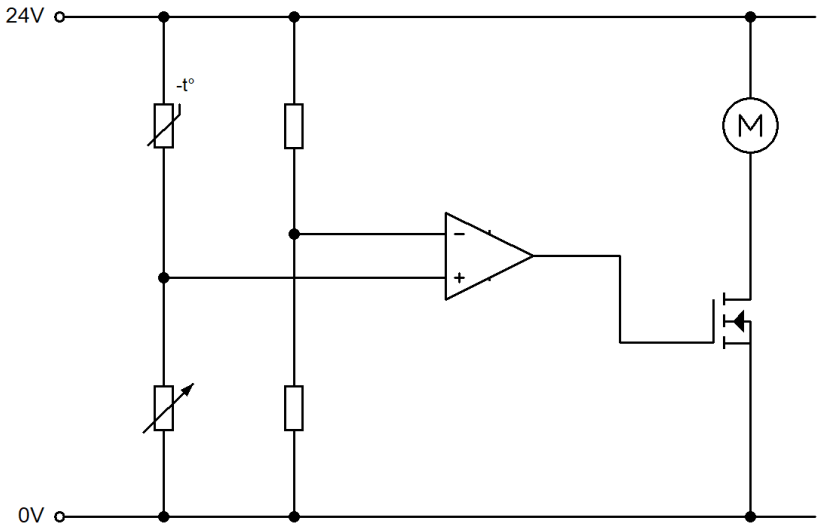
Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
1	(a)	(i)	 Both pins needed for mark	1			1	
		(ii)	A	1			1	
		(iii)	C	1			1	
		(iv)	OR gate	1			1	

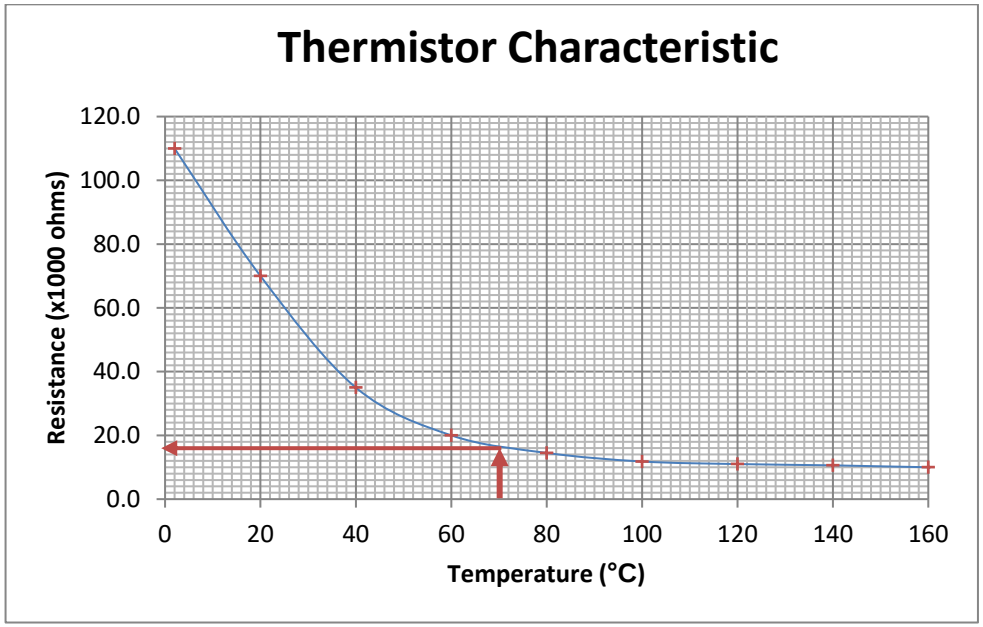
Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
	(b)	(i)	 2 inputs & Output connection required	1			1	
		(ii)	 2 inputs & Output connection required	1			1	
	(c)	(i)	B A Q 0 0 0 0 1 1 1 0 1 1 1 1	1			1	
		(ii)	B A Q 0 0 1 0 1 1 1 0 1 1 1 0	1			1	
			Question 1 total	**8**	**0**	**0**	**8**	**0**

Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
2	(a)		<table><tr><th>Input sub-system</th><th>Processing sub-system</th><th>Output sub-system</th></tr><tr><td>Light sensing unit</td><td>Latch unit</td><td>Solenoid unit</td></tr><tr><td>Moisture sensing unit</td><td>OR gate</td><td></td></tr><tr><td></td><td>Comparator</td><td></td></tr></table> 1 mark for each correct column	3			3	
	(b)		 1 mark for each correct box		2	5	7	
	(c)		Astable	1			1	
			Question 2 total	**4**	**2**	**5**	**11**	**0**

Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
3	(a)	(i)	$V_1 = 2.35V$ $I_1 = 5.5 – 0.5 = 5mA$ or $V/R = 2.35/470 = 5mA$ $V_2 = 6 – 2.35 = 3.65V$	2	1		3	2
		(ii)	$V = IR$ $R_3 = \frac{V}{I}$ *(1 – Rearranging)* $R_3 = \frac{3.65}{5.5\times10^{-3}}$ *(1 – Substitution)* $R_3 = 663.64\Omega$ *(1 – Answer)*	1	2		3	3
	(b)		Yellow (1) Violet (1) Brown (1) Silver (1)	4			4	0
			Question 3 total	**7**	**3**	**0**	**10**	**5**

Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
4	(a)	(i)	$I_{Load} = I_R – I_Z$ I_{Load} = 226 – 10 = 216mA	1	1		2	
		(ii)	5.1V	1			1	
	(b)		I is now 226mA ----------(New Current 1) P = V x I P = 5.1 x 226mA ----------(Formula & Substitution 1) P = 1.1526W ----------(Answer 1)	1	2		3	2
	(c)		Component 3	1			1	
	(d)	(i)	5.1V	1			1	
		(ii)	12-5.1 = 6.9V		1		1	1
			Question 4 total	**5**	**4**	**0**	**9**	**3**

Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
5	(a)		 Thermistor and Variable Resistor in Series connected to non-inverting-input – 1 Thermistor on top – 1		2		2	
	(b)		$V_- = \frac{V_{IN} \times R_2}{R_1 + R_2}$ *(1 – Formula)* $V_- = \frac{24 \times 30}{18 + 30}$ *or* $\frac{24 \times 30k}{18k + 30k}$ *(1 – Substitution)* $V_- = \frac{720}{48}$ *or* $\frac{720000}{48000}$ $V_- = 15V$ *(1 – Answer)*	1	2		3	3

Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
	(c)	(i)	 Plotting of data – 2 marks (-1 for each incorrect plot to minimum of zero) Smooth line through data points – 1		3		3	3
		(ii)	Suitable lines drawn on graph 17kΩ (accept 15 -18kΩ from graph)	1	1		2	1

Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
		(iii)	$V_+ = \frac{V_{IN} \times R_2}{R_1 + R_2}$ $V_+ = \frac{24 \times 35}{17+35}$ *or* $\frac{24 \times 35k}{17k+35k}$ *(1 – Substitution)* $V_+ = 16.15V$ *(1 – Answer)* $V_+ > V_-$ therefore the fan will be running. – 1 mark	1	2		3	3
			Question 5 total	**3**	**10**	**0**	**13**	**10**

<table>
<tr><th colspan="3" rowspan="2">Question</th><th rowspan="2">Marking details</th><th colspan="5">Marks available</th></tr>
<tr><th>AO1</th><th>AO2</th><th>AO3</th><th>Total</th><th>Maths</th></tr>
<tr><td rowspan="4">6</td><td rowspan="3">(a)</td><td>(i)</td><td>$X = A.B$</td><td>1</td><td></td><td></td><td>1</td><td>1</td></tr>
<tr><td>(ii)</td><td>$Y = \bar{C}$</td><td>1</td><td></td><td></td><td>1</td><td>1</td></tr>
<tr><td>(iii)</td><td>$Q = A.B + \bar{C}$ $(do\ not\ accept\quad Q = X + Y)$</td><td></td><td>1</td><td></td><td>1</td><td>1</td></tr>
<tr><td>(b)</td><td></td><td>
<table>
<tr><th>C</th><th>B</th><th>A</th><th>X</th><th>Y</th><th>Q</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>0</td><td>1</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>
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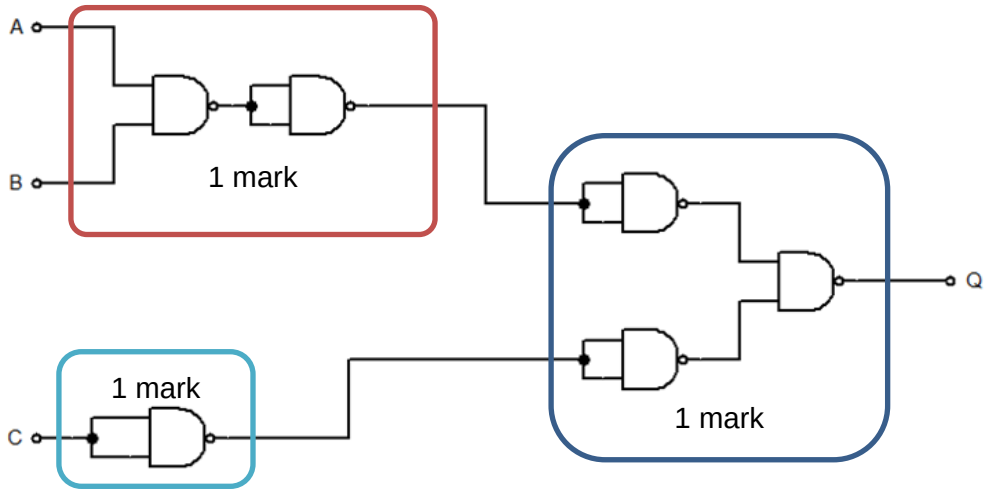
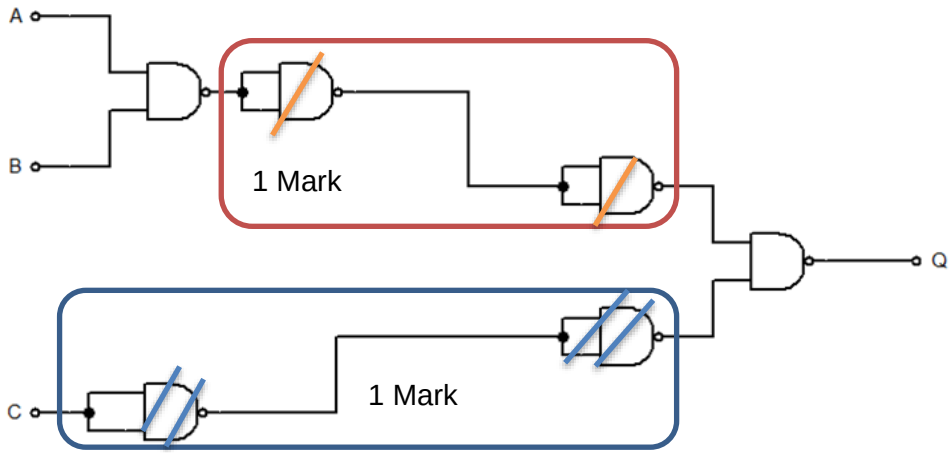
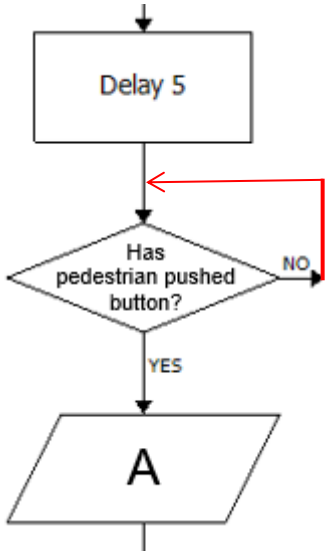
<tr><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td><td>1</td></tr>
</table>
1 mark per correct column – e.c.f. for Q if X or Y incorrect.
</td><td></td><td>3</td><td></td><td>3</td><td></td></tr>
</table>

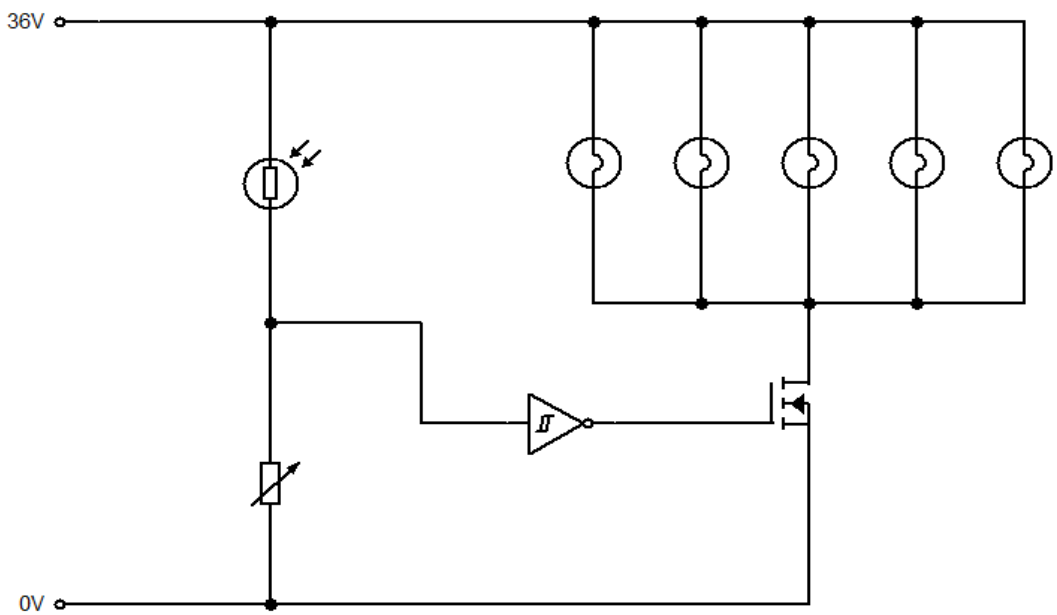
Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
	(c)	(i)		3			3	
		(ii)		2	0		2	
			Question 6 total	**7**	**4**	**0**	**11**	**3**

Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
7			**Indicative content:** The circuit does not fully meet the specification. There are a number of issues with the design as it stands. When the input is at 4V, Ib = (4-0.7) / 2k = 1.65mA. When this is amplified by the transistor, a collector current of 1.65mA x 200 = 330mA is produced which is insufficient for the motor to operate at full speed/power. The diode protection around the motor is also reversed and will prevent the motor from operating at all as the voltage across the motor will be capped at 0.7V, so it is unlikely to turn at all. Or $I_B = I_C / h_{FE}$ = 1 / 200 = 5mA; V2k = 5mA x 2k = 10V; V_{IN} = 10.7V, therefore with V_{IN} = 4V this is insufficient to produce the current required. The diode protection around the motor is also reversed and will prevent the motor from operating at all as the voltage across the motor will be capped at 0.7V, so it is unlikely to turn at all. The modifications needed are as follows: Rb needs to be decreased to 660Ω, in order to allow 5mA of base current to produce the 1A collector current required, or the transistor needs to be changed to one with a h_{FE} of >606 to produce a current of 1A from a base current of 1.65mA. The diode needs to be reversed in the protection circuit, so that it doesn't provide a route for current that bypasses the motor. **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. *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.*					

Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
			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. *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.* **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. *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.* **0 marks** No recognition that the specification is not met with no analysis or description of **any** issues identified in the indicative content. *Response not creditworthy or not attempted.*	0	1	5	6	2
			Question 7 total	**0**	**1**	**5**	**6**	**2**

Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
8	(a)		Turn on ‘green person’ sign – B Turn on ‘Wait’ sign – A Turn on ‘red person’ sign – C		3		3	
	(b)		 Delay 5s Correct link – 1 mark		1		1	
			Question 8 total	**0**	**4**	**0**	**4**	**0**

Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
9	(a)		$I_D = g_M(V_{GS} - 3)$ (1 – equation) $I_D = 1.35(10 - 3)$ (1 – substitution) $I_D = 9.45A$ (1 - answer)	1	2		3	3
	(b)		Current through each floodlight = 9.45 / 5 = 1.89A - (1) P = V x I P = 18 x 1.89 ----------(Substitution 1) P = 34.02W (34W) ----------(Answer 1)		3		3	2

Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
	(c)		 Reversal of sensing circuit – 1 mark Addition of Schmitt Inverter – 1 mark		2		2	
			Question 9 total	**1**	**7**	**0**	**8**	**5**
			TOTAL	**35**	**35**	**10**	**80**	**28**