



GCSE MARKING SCHEME

AUTUMN 2021

**GCSE
ELECTRONICS – COMPONENT 2
C490U20-1**

INTRODUCTION

This marking scheme was used by WJEC for the 2021 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 2021 MARK SCHEME
COMPONENT 2 – APPLICATION OF 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.

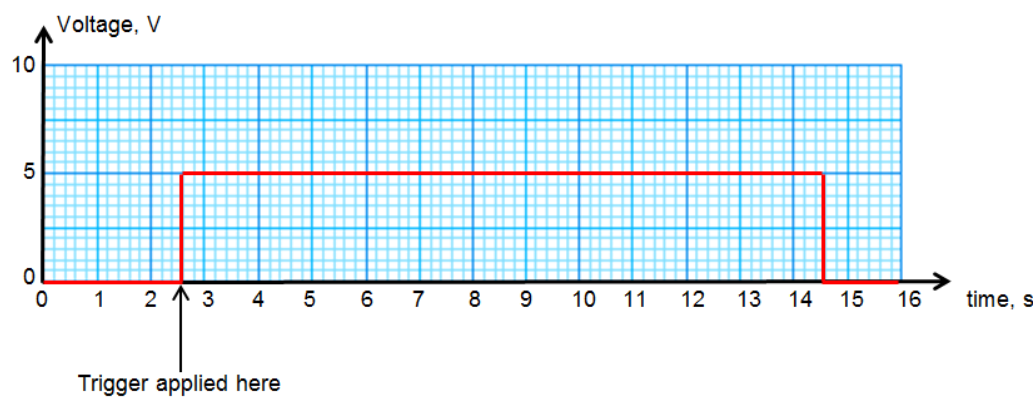
Marking abbreviations

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.		<p>OR</p> <p>2 Correct decision boxes – 2 mark 1 correct output box – 1 mark 2 correct 'No' outputs from decision boxes looping back to start – 1 mark Final output looped back to start or end of program/next part of program – 1 mark</p>	0	2	3	5	0
Question 1 Total			0	2	3	5	0

Question		Marking details	Marks available				
			AO1	AO2	AO3	Total	Maths
2.	(a)	<p>Resistor and switch in series chain – 1 mark Switch in bottom – 1 mark</p>	2			2	

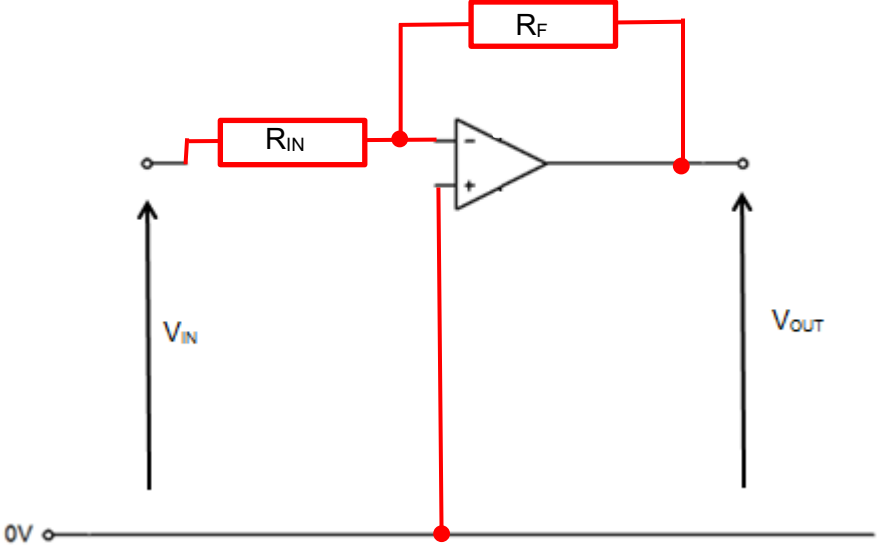
Question		Marking details	Marks available				
			AO1	AO2	AO3	Total	Maths
	(b)	 <p>Rising edge at 2.6s – 1 mark Falling edge at 14.6s – 1 mark Amplitude = 5V – 1 mark</p>	1	2		3	
	(c)	(i) <p>$Set A : T = 1.1 \times 5k \times 2200\mu F = 12.1s$</p> <p>$Set B : T = 1.1 \times 10k \times 1000\mu F = 11s$</p> <p>Use of $T=1.1RC$ - 1 mark</p> <p>Correct use of multipliers – 1 mark</p> <p>Set A produces the time delay closest to the 12s required – 1 mark</p>		3		3	1
		(ii) <p>Change R to a variable resistor</p>	1			1	0

Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
	(d)	(i)	470Ω	3			3	
		(ii)	$V = IR$ $I = \frac{V}{R} \quad (1 - \text{rearrangement})$ $I = \frac{5-1.95}{470} \quad (1 - \text{Substitution})$ $I = 6.489\text{mA} \approx 6.5\text{mA} \quad (1 - \text{Answer})$	1	2	0	3	3
Question 2 Total				8	7	0	15	4

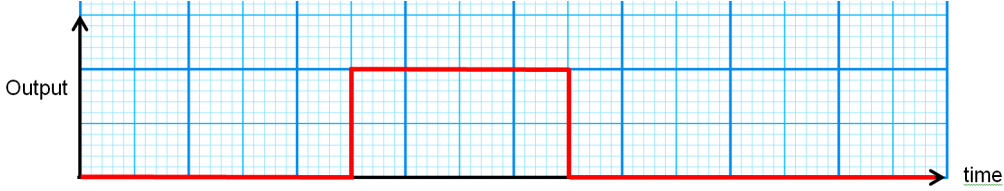
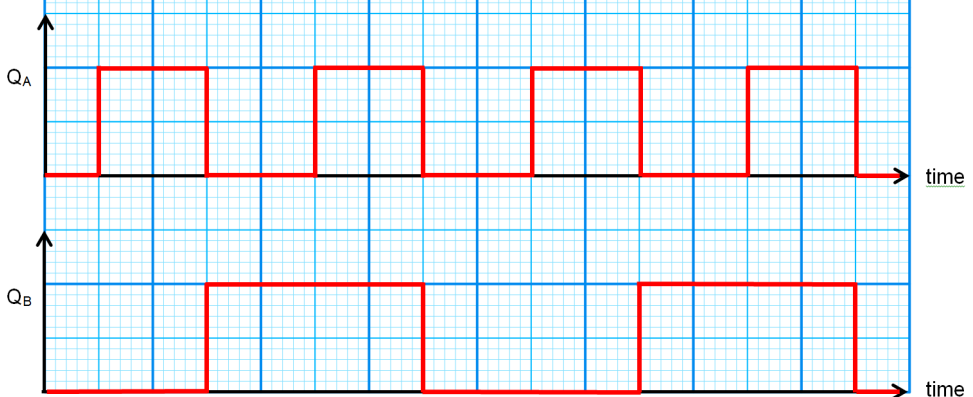
Question			Marking details			Marks available																																																											
						AO1	AO2	AO3	Total	Maths																																																							
3.	(a)		Binary Coded Decimal			1	0	0	1	0																																																							
	(b)		<table border="1"> <thead> <tr> <th>Clock Pulse</th> <th>Binary Counter Output</th> <th>BCD Counter Output</th> </tr> </thead> <tbody> <tr><td>0</td><td>0000</td><td>0000</td></tr> <tr><td>1</td><td>0001</td><td>0001</td></tr> <tr><td>2</td><td>0010</td><td>0010</td></tr> <tr><td>3</td><td>0011</td><td>0011</td></tr> <tr><td>4</td><td>0100</td><td>0100</td></tr> <tr><td>5</td><td>0101</td><td>0101</td></tr> <tr><td>6</td><td>0110</td><td>0110</td></tr> <tr><td>7</td><td>0111</td><td>0111</td></tr> <tr><td>8</td><td>1000</td><td>1000</td></tr> <tr><td>9</td><td>1001</td><td>1001</td></tr> <tr><td>10</td><td>1010</td><td>0000</td></tr> <tr><td>11</td><td>1011</td><td>0001</td></tr> <tr><td>12</td><td>1100</td><td>0010</td></tr> <tr><td>13</td><td>1101</td><td>0011</td></tr> <tr><td>14</td><td>1110</td><td>0100</td></tr> <tr><td>15</td><td>1111</td><td>0101</td></tr> <tr><td>16</td><td>0000</td><td>0110</td></tr> </tbody> </table> <p>1 mark for binary column correct 1 mark for BCD Output correct 0-9 + 1 mark for BCD output correct 10-16</p>			Clock Pulse	Binary Counter Output	BCD Counter Output	0	0000	0000	1	0001	0001	2	0010	0010	3	0011	0011	4	0100	0100	5	0101	0101	6	0110	0110	7	0111	0111	8	1000	1000	9	1001	1001	10	1010	0000	11	1011	0001	12	1100	0010	13	1101	0011	14	1110	0100	15	1111	0101	16	0000	0110						
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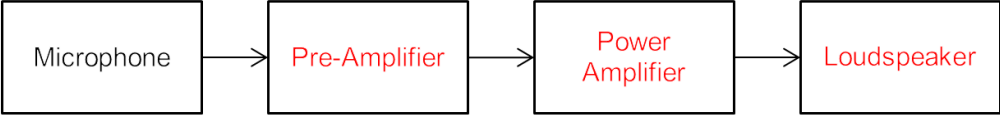
Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
	(c)		The 7 segment display can only display numbers from 0-9 (1).	0	1	0	1	0
			Question 3 Total	4	1	0	5	0

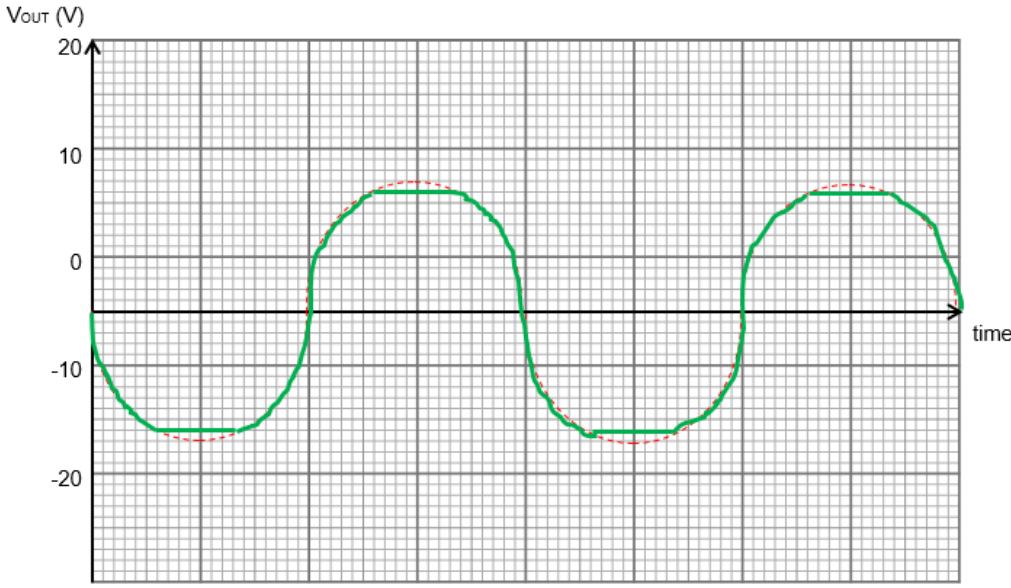
Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
4.	(a)	(i)	0.25V	0	1	0	1	1
		(ii)	14V	0	1	0	1	1
		(iii)	$gain = \frac{V_{OUT}}{V_{IN}}$ $gain = \frac{-14}{0.25}(1) = -56(1)$	1	1	0	2	2

Question		Marking details	Marks available				
			AO1	AO2	AO3	Total	Maths
	(b)	 <p> R_F from output to inverting input – (1) R_{IN} from inverting input to input – (1) Non-inverting input to 0V – (1) </p> $Gain = -\frac{R_F}{R_{IN}}$ <p> $-24 = -\frac{R_F}{R_1}$ (Formula & substitution – 1) $R_F = 24R_1$ (Rearrange and correct ratio – 1) e.g. $R_1 = 1k\Omega$, $R_F = 24k\Omega$ (Correct values $\geq 1k$ - 1) </p>	2	2	2	3	3
Question 4 Total			3	5	2	10	7

Question		Marking details	Marks available				
			AO1	AO2	AO3	Total	Maths
5.		<p>Correct identification of low-high transition – 1 mark Correct identification of high-low transition – 1 mark Correct low output threshold – 1 mark Correct high output threshold – 1 mark Output inverted – 1 mark</p>	4	1			
Question 5 total			4	1	0	5	4

Question		Marking details	Marks available				
			AO1	AO2	AO3	Total	Maths
6.	(a)	 <p>Q starting low – 1 mark Two correct transitions – 1 mark each</p>	2	1	0	3	
	(b)	 <p>QA half frequency of Clock starting on first rising edge of clock – 1 mark QB half frequency of QA – 1 mark QB changes on falling edge of QA – 1 mark</p>	2	1		3	
		Question 6 Total	4	2	0	6	0

Question		Marking details	Marks available				
			AO1	AO2	AO3	Total	Maths
7.	(a)	 <p>1 mark for each correct box</p>	3	0	0	4	0
	(b)	$gain = 1 + \frac{R_F}{R_1}$ ----- Formula (1) $gain = 1 + \frac{750k}{15k}$ ----- Substitution (1) $gain = 1 + 50 = 51$ ----- Answer (1)	1	2	0	3	3

Question		Marking details	Marks available				
			AO1	AO2	AO3	Total	Maths
(c)	(i)	 <p>Non inverted compared to input – 1 mark Same frequency – 1 mark Clipped at $\pm 11\text{V}$ – 1 mark</p>	2	1	0	3	1
	(ii)	<p>Gain-bandwidth product = gain x bandwidth</p> <p>$4\,000\,000 = 40 \times \text{bandwidth}$</p> <p>Bandwidth = $4\,000\,000 / 40 = 100\,000\text{Hz}$ or 100 kHz</p>	1	2		3	2
		Question 7 Total	7	5	0	12	6

Question		Marking details	Marks available				
			AO1	AO2	AO3	Total	Maths
8.		<p>Indicative Content:</p> <p>The student has correctly configured the sensing circuit so that the voltage at the gate of the MOSFET will be rising as the light level decreases.</p> <p>At the given level of voltage of $V_{GS} = 15V$ this will provide the appropriate current for the floodlight. Use of $I_D = g_M (V_{GS} - 3) = I_D = 2 (15 - 3) = 24A$.</p> <p>The specification states that the light level needed to operate the floodlight should be adjustable. The circuit does not satisfy this as the resistor is of fixed value and needs to be made into a variable resistor.</p> <p>Finally the response of the circuit will not be very sharp, and would benefit from the addition of a Schmitt Inverter between the sensing circuit and the MOSFET. The LDR and variable resistor would also need to be reversed.</p> <p>5-6 marks Candidates have evaluated the specification fully e.g. all statements considered against the given circuit, justifying values and selection of components in the design and given a comprehensive description of changes that should be made. Description has a logical thought process and presentation.</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>					

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	
			<p>3-4 marks Candidates have evaluated most of the specification e.g. all statements considered against the given circuit, however justification of values and selection of components in the design may be less clear and given a brief description of changes that should be made. Description has a reasonable thought process and presentation.</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> <p>1-2 marks Candidates have evaluated little of the specification e.g. one of the statements with the given circuit, justification of values and selection of components in the design may be weak and limited description of changes that should be made. Description has a random presentation.</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 evaluation of circuit against specification or any statement of value.</p> <p><i>Response not creditworthy or not attempted.</i></p>						
			Question 8 total	0	1	5	6	2	

Question			Marking details			Marks available																																																																
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9.	(a)	(i)	Red output = \bar{C} - 1 mark				1		1																																																													
		(ii)	Yellow Output = $A.B$ – 1 mark				1		1																																																													
	(b)		<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="3">Counter Outputs</th> <th colspan="3">Light Outputs</th> </tr> <tr> <th>C</th> <th>B</th> <th>A</th> <th>Red</th> <th>Yellow</th> <th>Green</th> </tr> </thead> <tbody> <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>1</td> <td>0</td> <td>0</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>1</td> <td>1</td> <td>0</td> </tr> <tr> <td>1</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>1</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>0</td> <td>0</td> <td>1</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>0</td> <td>1</td> <td>0</td> </tr> </tbody> </table> <p>1 mark for each correct Output Column</p>			Counter Outputs			Light Outputs			C	B	A	Red	Yellow	Green	0	0	0	1	0	0	0	0	1	1	0	0	0	1	0	1	0	0	0	1	1	1	1	0	1	0	0	0	0	1	1	0	1	0	0	1	1	1	0	0	0	1	1	1	1	0	1	0		3		3	
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	(c)	(i)	$frequency = \frac{1.44}{(R_1 + 2R_2) \times C} \quad \text{----- Formula (1)}$ $frequency = \frac{1.44}{(33k\Omega + 2 \times 75k\Omega) \times 470\mu F}$ $frequency = \frac{1.44}{33 \times 10^3 + 150 \times 10^3 \times 470 \times 10^{-6}} \quad \text{----- Substitution (1)}$ $frequency = 0.0167 \text{ Hz} \quad \text{----- Answer (1)}$			1	2		3	3																																																												

Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
	(ii)	$frequency = \frac{1}{T}$ ----- Formula (1) $period = \frac{1}{0.0167}$ ----- Rearrangement & Substitution (1) $period = 59.88s \cong 60s$ ----- Answer (1)	1	2		3	2	
	(d)	Red output is on for 4 cycles in each sequence. ----- Correct no of periods (1) Red output is on for 4 x 60s = 240s ----- Answer (1)	1	1		2	2	
	(e)	$frequency = \frac{1}{T}$ ----- Formula (1) $frequency = \frac{1}{5 \times 2ms}$ ----- Substitution of correct period (1) $frequency = 100Hz$ ----- Answer (1)	1	2		3	2	
Question 9 Total			4	12	0	16	9	
Paper Total			35	35	10	80	32	