GCSE MARKING SCHEME

SUMMER 2023

GCSE
ELECTRONICS – COMPONENT 2
C490U20-1

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 2 – APPLICATION OF 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.

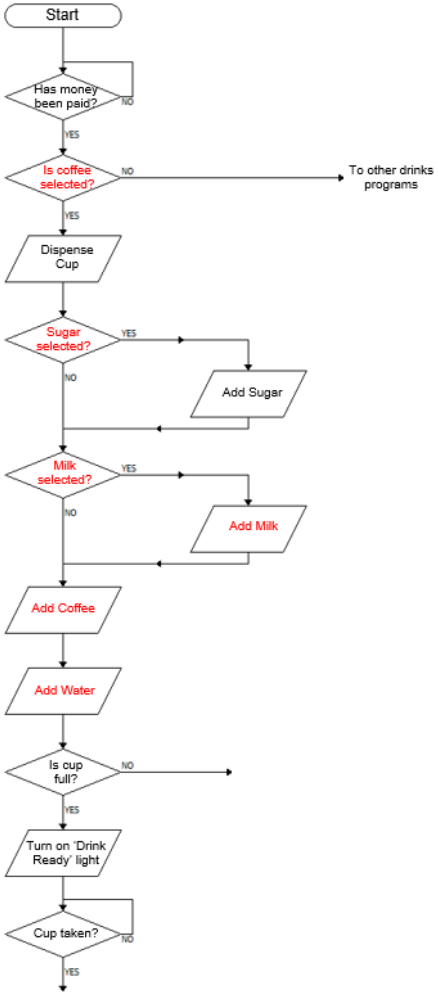
Extended response question

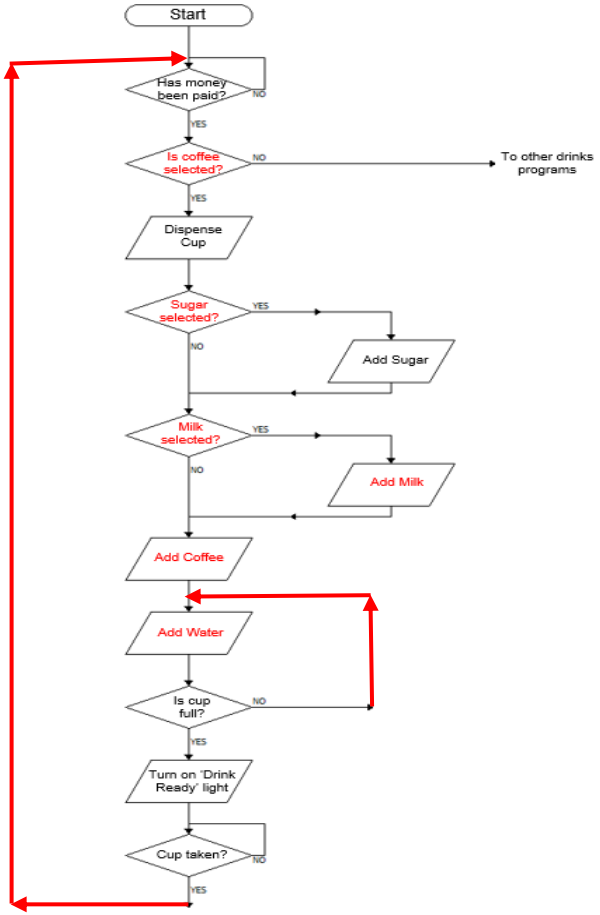
A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide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

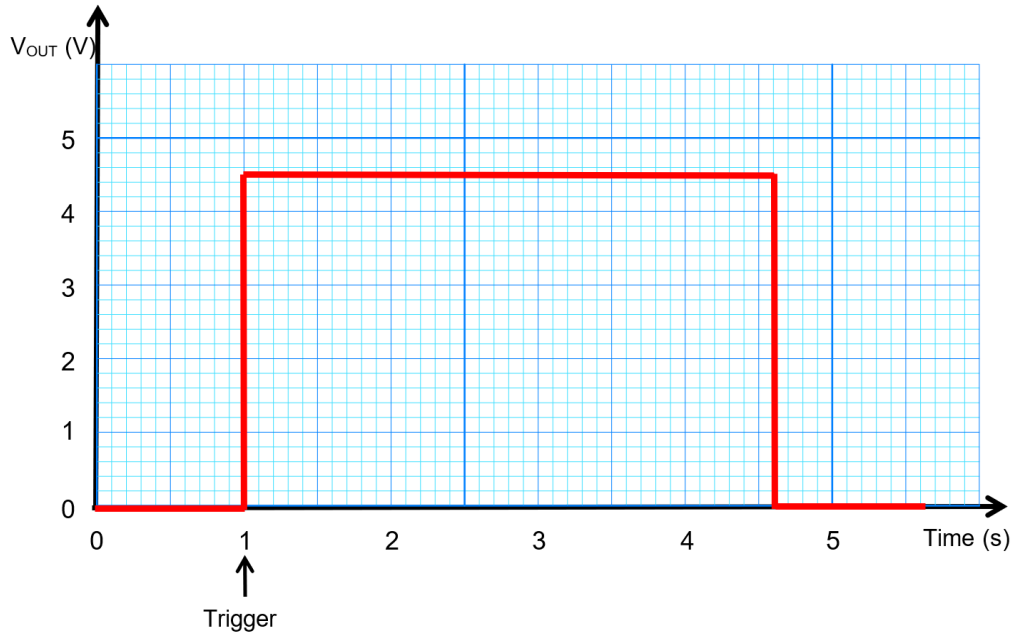
Marking abbreviations

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

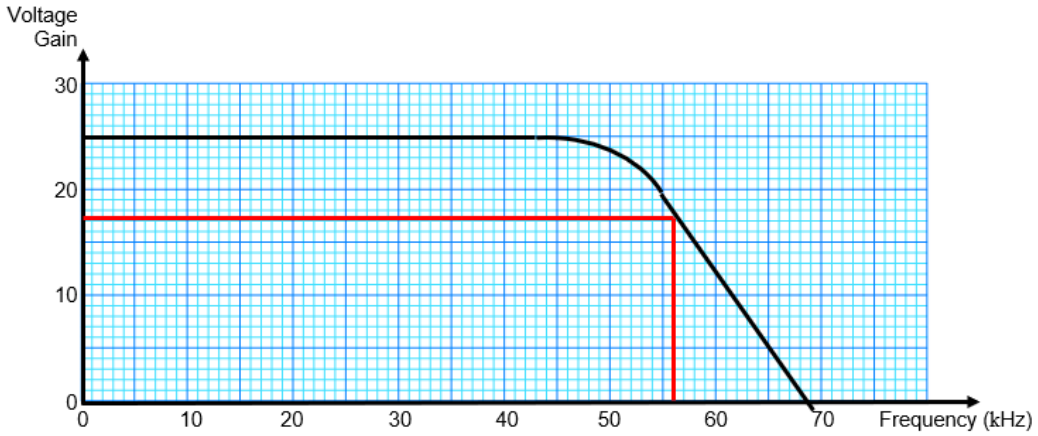
Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
1	(a)		 2 correct boxes = 1 mark 3 correct boxes = 2 marks; 4 correct boxes = 3 marks; All correct = 4 marks	4			4	

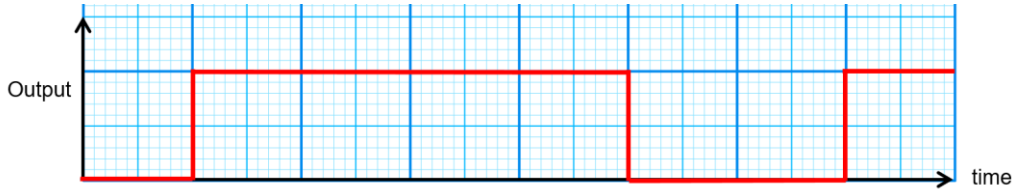
Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
	(b)		 1 mark for each correct link	2			2	
			Question 1 total	**6**	**0**	**0**	**6**	**0**

Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
2	(a)		 Appropriate scale added to y-axis – 1 Correct pulse duration from start – 1 Correct maximum amplitude – 1	2	1		3	3
	(b)	(i)	3cm x 5V/cm = 15V		1		1	1
		(ii)	I. 3.4cm x 2ms = 6.8ms		1		1	1
			II. 1.6cm x 2ms = 3.2ms		1		1	1

Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
			III. Period = 3.2ms + 6.8ms = 10ms – 1 mark $f = \frac{1}{T}$ ……(1) $f = \frac{1}{10ms} = 100Hz$ ……(1)	1	2		3	3
			Question 2 total	**3**	**6**	**0**	**9**	**9**

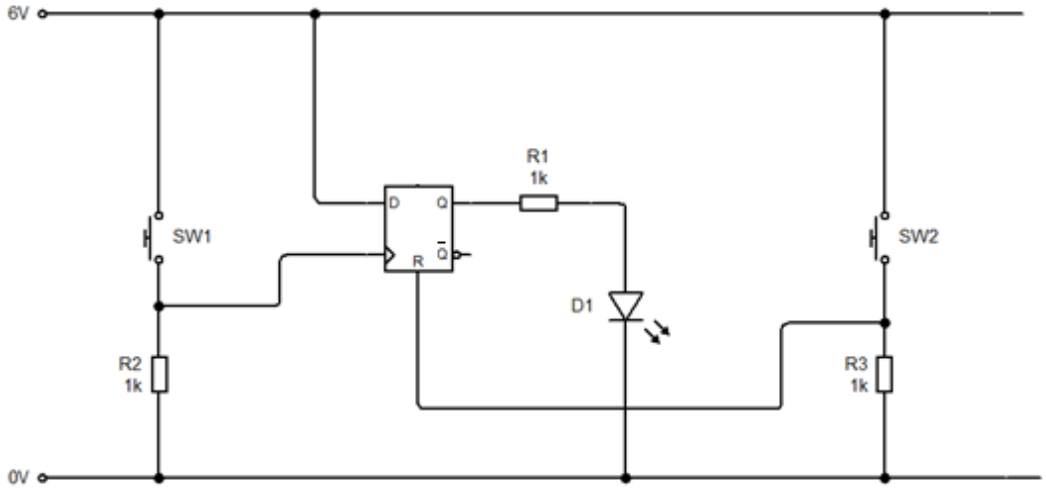
Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
3	(a)		$Gain = -\frac{R_F}{R_{IN}}$ (Formula – 1) $Gain = -\frac{360}{18}$ (Substitution – 1) $Gain = -20$ (Answer inc '– ' sign – 1)	1	2	0	3	3
	(b)	(i)	0.5V (1)		1		1	1
		(ii)	V_{OUT} = 20 x 0.5 = 10V – (1) Do not penalise missing '– '	1			1	1
		(iii)	Sine wave with same frequency as V_{IN} – (1) Inverted - (1) Peak Amplitude at ±10V – (1)	2	1		3	1
	(c)		Sine wave with same frequency as V_{IN} – (1) Non-Inverted - (1) Clipped at ±13V – (1)	2	1		3	1
			Question 3 total	**6**	**5**	**0**	**11**	**7**

Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
4	(a)		25	1			1	1
	(b)		 Gain of 0.7 x 25 = 17.5 (1) Appropriate lines drawn at gain = 17.5 (1) Bandwidth identified at 56kHz (1)	1	2		3	2
	(c)		Increased (1) by factor of 2 (1) {Doubled = 2 marks}		2		2	1
			Question 4 total	**2**	**4**	**0**	**6**	**4**

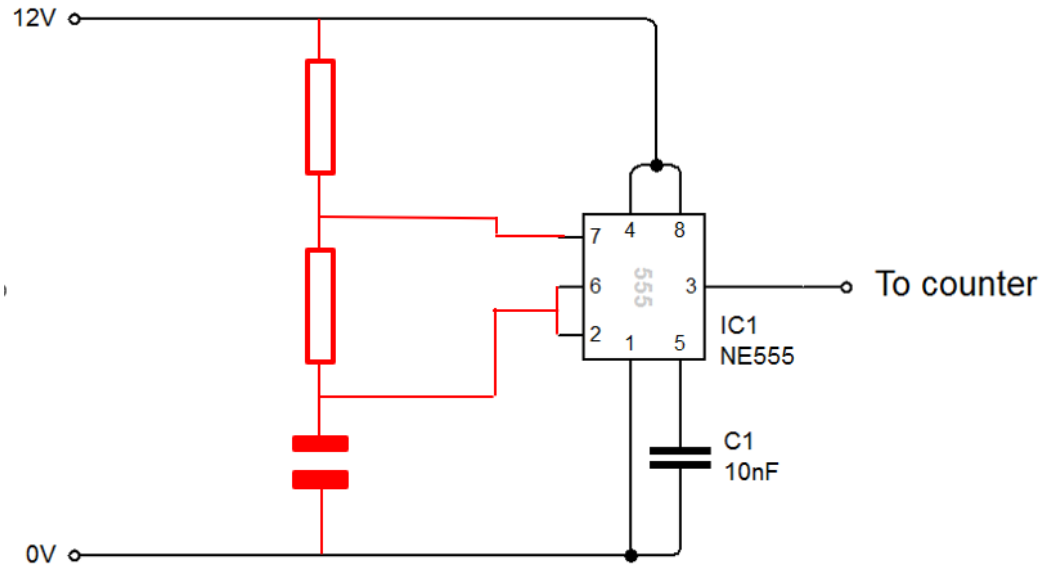
<table>
<tr><th colspan="3" rowspan="2">Question</th><th rowspan="2">Marking details</th><th colspan="5">Marks available</th></tr>
<tr><th>AO1</th><th>AO2</th><th>AO3</th><th>Total</th><th>Maths</th></tr>
<tr><td>5</td><td>(a)</td><td></td><td> 

Q starting low – 1 mark
Three correct transitions – 1 mark each {Additional Transitions -1}</td><td>1</td><td>3</td><td>0</td><td>4</td><td></td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td><table>
<tr><th>Clock Pulse</th><th>LED$_1$</th><th>LED$_2$</th></tr>
<tr><td>Start</td><td>Off</td><td>Off</td></tr>
<tr><td>1</td><td>On</td><td>Off</td></tr>
<tr><td>2</td><td>Off</td><td>On</td></tr>
<tr><td>3</td><td>On</td><td>On</td></tr>
<tr><td>4</td><td>Off</td><td>Off</td></tr>
<tr><td>5</td><td>On</td><td>Off</td></tr>
</table>
LED$_1$ column correct – 1 mark
LED$_2$ column correct – 1 mark</td><td>2</td><td></td><td></td><td>2</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>I. 0.05 Hz – 1 mark

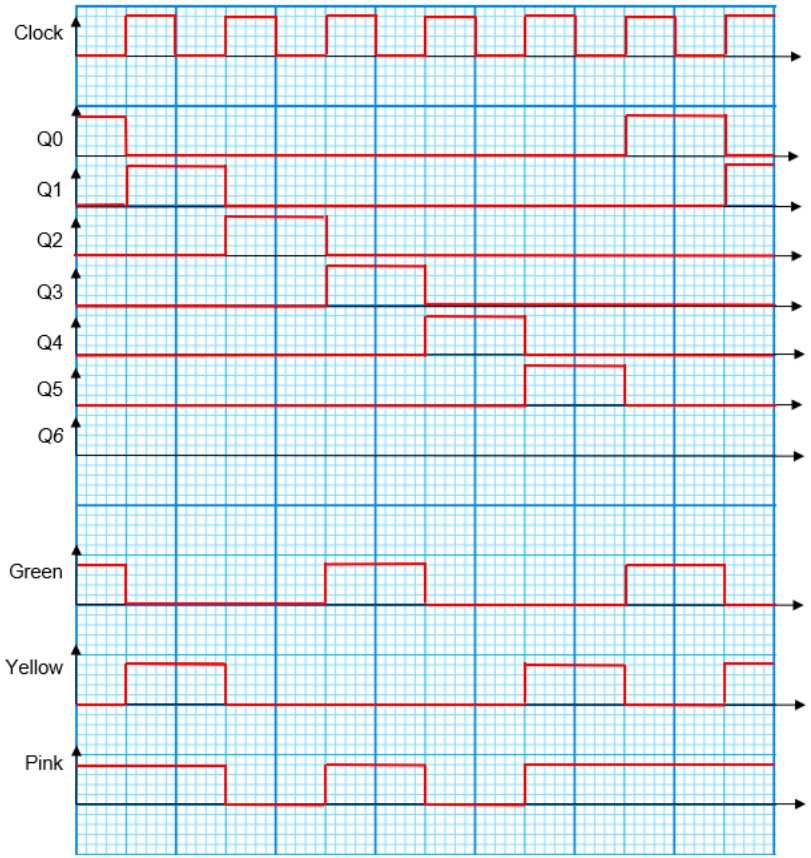
II. 0.025 Hz – 1 mark</td><td></td><td>2</td><td></td><td>2</td><td>2</td></tr>
<tr><td></td><td></td><td>(iii)</td><td>$f = \frac{1}{T}$
$T = \frac{1}{f}$ ---------- (1 rearrangement)
$T = \frac{1}{0.025 \times 2} = 20s$ ---------- (1 Substitution / 1 Answer)</td><td>2</td><td>1</td><td></td><td>3</td><td>3</td></tr>
</table>

Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
	(c)		 D input connected to 6V – 1 SW1 connected in series with pull down resistor – 1 SW2 connected in series with pull down resistor – 1 Junction of SW1 and pull down resistor connected to clock input – 1 Junction of SW2 and pull down resistor connected to reset input – 1	1	0	4	5	0
			Question 5 total	**6**	**6**	**4**	**16**	**5**

<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>6</td><td>(a)</td><td>(i)</td><td>
<table>
<tr><th colspan="3">Counter Outputs</th><th colspan="3">Display Outputs</th></tr>
<tr><th>C</th><th>B</th><th>A</th><th>Red Light</th><th>Amber Light</th><th>Green Light</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>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>
</table>
Correct display outputs – 1 mark</td><td>1</td><td></td><td>0</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Red Light = $\bar{C}$</td><td></td><td>1</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td></td><td></td><td>(iii)</td><td>Amber Light = $\bar{C}.B.A + C.B.A$ Accept $(A.B)$ – 3 marks
$\bar{C}.B.A$ – 1 mark
$C.B.A$ – 1 mark
OR operand – 1 mark</td><td>1</td><td>2</td><td>0</td><td>3</td><td>3</td></tr>
</table>

Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
	(b)		 2 resistors + capacitor in series – 1 mark. Orientation of resistors / capacitors – 1 mark Connection to pin 6/2 – 1 mark Connection to pin 7 – 1 mark	1	1	2	4	0

Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
	(c)		$V = IR$ $R = \frac{V}{I}$ (formula & manipulation = 1) $R = \frac{12 - 2.1 - 2.1}{25 \times 10^{-3}}$ …… (use of 2 diodes − 1 / substitution – 1) $R = 312\Omega$ (ideal answer - 1) $R = 330\Omega$ (Correct preferred value – 1; Do NOT accept 300Ω)	2	3	0	5	4
			Question 6 total	**5**	**7**	**2**	**14**	**8**

Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
7								

Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
			Mark allocation • Waveform before reset correct– 1 mark • Waveform after reset correct – 1 mark • Reset observed at Q6 – 1 mark • Green correct – 1 mark • Yellow correct – 1 mark • Pink correct – 2 marks (Inverted – 1 mark)	4	3		7	0
			Question 7 Total	**4**	**3**	**0**	**7**	**0**

Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
8	(a)		$V_{OUT} = -R_F\left\{\frac{V_1}{R_1} + \frac{V_2}{R_2}\right\} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1 - Equation)$ $V_{OUT} = -75\left\{\frac{3}{30} + \frac{-3}{150}\right\} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1 - Substitution)$ $V_{OUT} = -75\{0.1 - 0.02\} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1 - Manipulation)$ $V_{OUT} = -6V \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1 - Answer)$	1	3		4	4
	(b)		The modified design is more useful because different amounts of the input signal can be passed into the mixer because of the potentiometer allowing anything from 0 to 100% of the input through to the mixer (1).	1			1	
			Question 8 total	**2**	**3**	**0**	**5**	**4**

Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
9			**Indicative content:** The timing circuit is correctly configured with the 555 IC as a Monostable, however the trigger function needs to provide a logic 0 to trigger the timer when motion is detected. The sensor provides a logic 1 when motion is detected. An inverter therefore needs to be applied to the Motion Sensor Output to provide the correct trigger signal for the monostable. The time interval specified is approximately 20 seconds. Using the components specified the time delay will be 1.1 x 390kΩ x 470µF = 201.63s which is approximately 10 times too long therefore either R_1 or C_1 need to be reduced by a factor of 10 in order to satisfy this part of the specification. The output current capability of a 555 timer is a maximum of 200mA, the output current required for the siren is 3A. The 555 cannot therefore provide enough current and so a transistor switch or MOSFET driver needs to be connected between the output of the 555 and the siren. The siren will switch off when the timing period has expired once the input is correctly changed otherwise it will be on permanently. **5-6 marks** Candidates have evaluated the specification fully e.g. all three 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. *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 Candidates have evaluated most of the specification e.g. two of the three statements with the given circuit, 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. *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** Candidates have evaluated little of the specification e.g. one of the three 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. *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 evaluation of circuit against specification or any statement of value. *Response not creditworthy or not attempted.*	1	1	4	6	2
			Question 9 total	**1**	**1**	**4**	**6**	**2**
			Paper total	**35**	**35**	**10**	**80**	**39**