



GCSE MARKING SCHEME

SUMMER 2024

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

About this marking scheme

The purpose of this marking scheme is to provide teachers, learners, and other interested parties, with an understanding of the assessment criteria used to assess this specific assessment.

This marking scheme reflects the criteria by which this assessment was marked in a live series and was finalised following detailed discussion at an examiners' conference. A team of qualified examiners were trained specifically in the application of this marking scheme. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners. It may not be possible, or appropriate, to capture every variation that a candidate may present in their responses within this marking scheme. However, during the training conference, examiners were guided in using their professional judgement to credit alternative valid responses as instructed by the document, and through reviewing exemplar responses.

Without the benefit of participation in the examiners' conference, teachers, learners and other users, may have different views on certain matters of detail or interpretation. Therefore, it is strongly recommended that this marking scheme is used alongside other guidance, such as published exemplar materials or Guidance for Teaching. This marking scheme is final and will not be changed, unless in the event that a clear error is identified, as it reflects the criteria used to assess candidate responses during the live series.

GCSE ELECTRONICS
COMPONENT 2 – APPLICATION OF ELECTRONICS
SUMMER 2024 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	<pre> graph TD Start([Start]) --> Init[Let Count = 0] Init --> Load[Load Empty Box] Load --> Jar{Is Jar Present?} Jar -- NO --> Reject[Reject Jar] Jar -- YES --> Print[/Print BBE Date/] Print --> Read{Can BBE date be read?} Read -- NO --> Reject Read -- YES --> LoadJar[/Load Jar in Box/] LoadJar --> Inc[Let Count = Count + 1] Inc --> Count{Is Count = 12?} Count -- NO --> Reject Count -- YES --> Seal[/Seal Box/] Seal --> Dispatch[/Send to Dispatch/] Dispatch --> Load </pre> <p>1 mark for each correct box</p>	5	0	0	5	0

Question		Marking details	Marks available				
			AO1	AO2	AO3	Total	Maths
1	b	<pre> graph TD Start([Start]) --> Init[Let Count = 0] Init --> Load[Load Empty Box] Load --> Jar{Is Jar Present?} Jar -- NO --> Load Jar -- YES --> Print[/Print BBE Date/] Print --> Read{Can BBE date be read?} Read -- NO --> Reject[Reject Jar] Read -- YES --> LoadJar[/Load Jar in Box/] LoadJar --> Inc[Let Count = Count + 1] Inc --> Count{Is Count = 12?} Count -- NO --> Reject Count -- YES --> Seal[/Seal Box/] Seal --> Dispatch[/Send to Dispatch/] Dispatch --> Load </pre> <p>1 mark for each correct link</p>	0	2	0	2	0
Question 1 Total			5	2	0	7	0

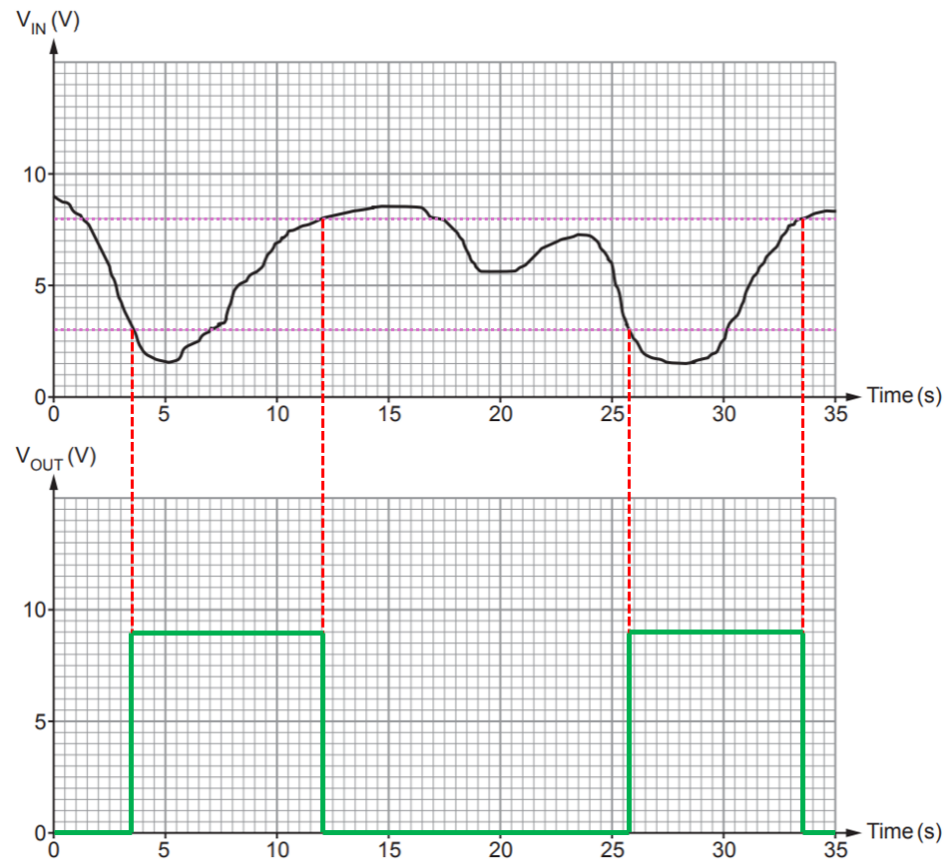
Question		Marking details	Marks available				
			AO1	AO2	AO3	Total	Maths
2	a	<p>1 0 000Ω</p> <p>1 = 1 mark 0 = 1 mark 000 = 1 mark (allow 'k')</p>	3	0	0	3	0
	b (i)	<p>$T = 1.1 \times R \times C$ (Formula = 1 mark)</p> <p>$T = 1.1 \times 35k \times 4700\mu F$ (Substitution = 1 mark)</p> <p>$T = 180.95s \approx 180s \approx 3 \text{ minutes}$ (Answer {with unit} = 1 mark)</p>	1	2	0	3	2
	(ii)	<p>$R = \frac{T}{1.1 \times C}$ (Rearrangement = 1 Mark)</p> <p>$R = \frac{8 \times 60}{1.1 \times 4700 \times 10^{-6}}$ (Correct calculation of 8 minutes – 1 mark) (Correct multipliers – 1 Mark)</p> <p>$R = 92843.33 \Omega \cong 93k\Omega$ (Correct Answer – 1 Mark)</p> <p>$VR_1 = 93k\Omega - 35k\Omega = 58k\Omega$ (Correct minimum value – 1 Mark)</p>	2	3	0	5	3
	c	<p>When the switch is pressed the output of the 555 timer goes high (1). The buzzer comes on and sounds continuously until the time delay has elapsed.(1) or When the switch is pressed the output of the 555 timer goes high (1) and stays high until the time delay has finished (1)</p>	0	2	0	2	0
Question 2 Total			6	7	0	13	5

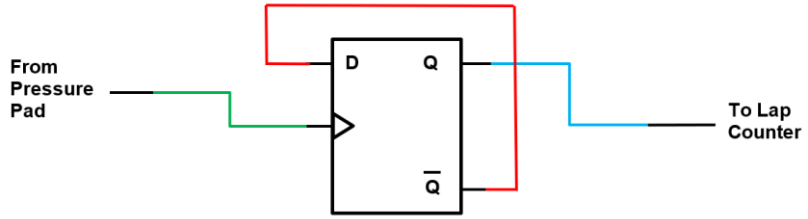
Question			Marking details				Marks available				Maths																																																											
							AO1	AO2	AO3	Total																																																												
3	a	(i)	<table border="1"> <thead> <tr> <th>Clock Pulse</th> <th>D</th> <th>C</th> <th>B</th> <th>A</th> </tr> </thead> <tbody> <tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>1</td><td>0</td><td>0</td><td>0</td><td>1</td></tr> <tr><td>2</td><td>0</td><td>0</td><td>1</td><td>0</td></tr> <tr><td>3</td><td>0</td><td>0</td><td>1</td><td>1</td></tr> <tr><td>4</td><td>0</td><td>1</td><td>0</td><td>0</td></tr> <tr><td>5</td><td>0</td><td>1</td><td>0</td><td>1</td></tr> <tr><td>6</td><td>0</td><td>1</td><td>1</td><td>0</td></tr> <tr><td>7</td><td>0</td><td>1</td><td>1</td><td>1</td></tr> <tr><td>8</td><td>1</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>9</td><td>1</td><td>0</td><td>0</td><td>1</td></tr> <tr><td>10</td><td>1</td><td>0</td><td>1</td><td>0</td></tr> </tbody> </table> <p>All correct – 1 Mark</p>	Clock Pulse	D	C	B	A	0	0	0	0	0	1	0	0	0	1	2	0	0	1	0	3	0	0	1	1	4	0	1	0	0	5	0	1	0	1	6	0	1	1	0	7	0	1	1	1	8	1	0	0	0	9	1	0	0	1	10	1	0	1	0							
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10	1	0	1	0																																																																		
		(ii)	<p>1 Mark for each correct connection 1 Mark for AND gate</p>																																																																			

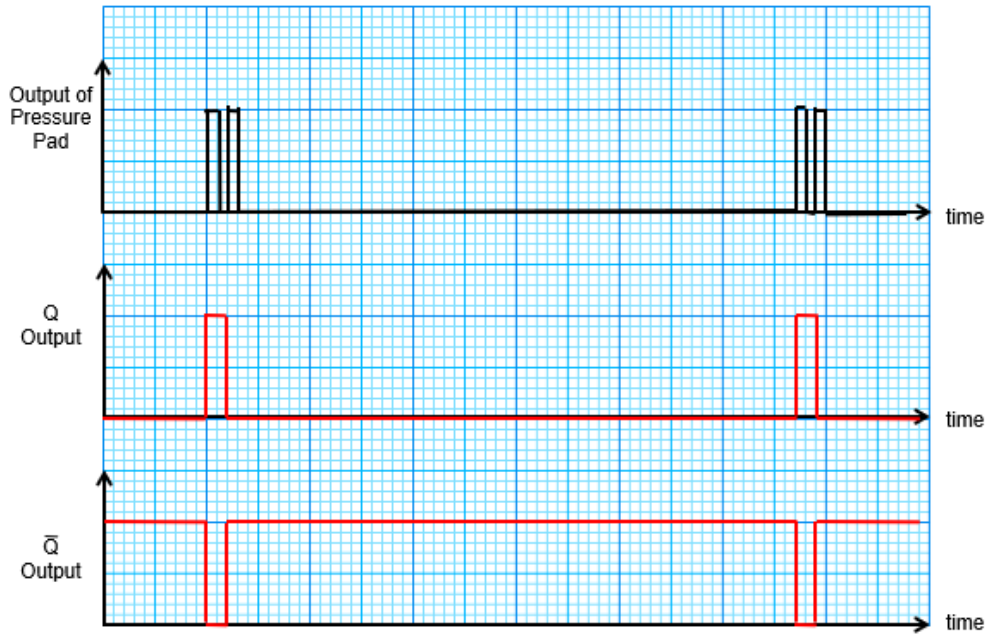
Question			Marking details	Marks available				Maths
				AO1	AO2	AO3	Total	
	<i>b</i>		F	1	0	0	1	0
			S	1	0	0	1	0
			0001110	1	0	0	1	0
			Question 3 Total	5	0	3	8	0

Question		Marking details	Marks available				
			AO1	AO2	AO3	Total	Maths
4		<p>Indicative Content: The required gain of the amplifier is -12 (+15/-1.25) The circuit design is incorrectly configured as an inverting amplifier. The feedback resistor should be connected to the inverting input and the non-inverting input should be connected to zero. There should be no connection between the inverting and non-inverting inputs. The actual gain of the amplifier is -9 (-270k/30k) which does not match the specification. The resistors need to be changed to give a ratio of 12:1, so 360k and 30k, or 270k and 22.5k would be suitable. The maximum output required is 15V with an 18V power supply so there should be no danger of clipping distortion taking place.</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> <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>					

Question		Marking details	Marks available				
			AO1	AO2	AO3	Total	Maths
4		<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 4 total	1	1	4	6	4

Question	Marking details	Marks available				Maths
		AO1	AO2	AO3	Total	
5	 <p>Correct</p> <p>LOW output threshold (0V) – 1 mark Correct HIGH output threshold (9V) – 1 mark 2 x Low-High transition @3.5s and 25.75s ($\pm 0.25s$) – 1 mark 2 x High-Low transition @12s and 33.5s ($\pm 0.25s$) – 1 mark Output inverted (2 pulses) – 1 ma</p>					
Question 5 total		4	1	0	5	4

Question		Marking details	Marks available				
			AO1	AO2	AO3	Total	Maths
6	a	The divide-by-two circuit is needed because each cycle has two wheels so there will be two pulses from the pressure pad <u>every lap</u> .	1	0	0	1	0
	b	 <p>Pressure Pad connected to 'Clock' input – 1 mark Q connected to Lap Counter – 1 mark Qbar connected to 'D' input – 1 mark</p>	0	0	3	3	0

Question		Marking details	Marks available				
			AO1	AO2	AO3	Total	Maths
C		 <p>Q output starts at Logic 0 – 1 Mark Q goes high at 1st & 3rd rising edge of pressure pad – 1 Mark Q goes low at 2nd and 4th rising edge of pressure pad – 1 Mark Q bar is inverse of Q – 1 Mark</p>	2	2	0	4	2
Question 6 Total			3	2	3	8	2

Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
7	a		Pulse Generator	1	0	0	1	0
	b	(i)	Amplitude = $5 \times 250\text{mV} = 1250 \text{ mV}$ or 1.25V	1	0	0	1	1
		(ii)	Period = $3 \times 2\text{ms} = 6\text{ms}$	1	0	0	1	1
	c		Mark: Space ratio is 2:1	1	0	0	1	1
	d	(i)	$T_{ON} = 0.7 \times (R_1 + R_2) \times C$ $T_{ON} = 0.7 \times (1 \times 10^3 + 100 \times 10^3) \times 1000 \times 10^{-6}$ substitution – 1 multipliers - 1 $T_{ON} = 70.7\text{s}$ answer – 1	1	2	0	3	2
		(ii)	$T_{OFF} = 0.7 \times R_2 \times C$ $T_{OFF} = 0.7 \times 100 \times 10^3 \times 1000 \times 10^{-6}$ substitution – 1 multipliers - 1 $T_{OFF} = 70\text{s}$ answer – 1	1	2	0	3	2

Question		Marking details	Marks available				
			AO1	AO2	AO3	Total	Maths
	(iii)	<p>Voltage</p> <p>An equal mark / space waveform by eye. ecf</p>	0	1	0	1	0
	(iv)	<p>Either</p> $f = \frac{1}{T} = \frac{1}{70.7\text{ecf} + 70\text{ecf}} = 0.0071\text{Hz} = 7.1\text{mHz}$ <p>Or</p> $f = \frac{1.44}{(R_1 + 2R_2) \times C}$ $f = \frac{1.44}{(1 \times 10^3 + (2 \times 100 \times 10^3) \times 1000 \times 10^{-6})} = 0.0071\text{Hz} = 7.1\text{mHz}$ <p>Formula selection – 1 Mark / Substitution – 1 Mark / Answer – 1 Mark</p>	1	2	0	3	2
Question 7 Total			7	7	0	14	9

Question		Marking details		Marks available				
				AO1	AO2	AO3	Total	Maths
8	a	$Gain = 1 + \frac{R_F}{R_1}$ $Gain = 1 + \frac{240}{10}$ $Gain = 1 + 24 = 25$	Selection of correct equation – 1 mark Substitution – 1 mark Answer - 1 Mark	1	2	0	3	2
	b	$Gain = \frac{V_{OUT}}{V_{IN}}$ $V_{IN_{Max}} = \frac{V_{OUT_{Max}}}{Gain}$ $V_{IN_{Max}} = \frac{14}{25} = 0.56V$	Selection of correct equation – 1 Mark Rearrangement – 1 Mark Substitution – 1 Mark / Answer - 1 Mark	1	3	0	4	3
	c	100,000Hz or 100kHz	Answer – 1 Mark	0	1	0	1	1
Question 8 Total				2	6	0	8	6

Question		Marking details		Marks available				Maths
				AO1	AO2	AO3	Total	
9	a	$I_D = g_M(V_{GS} - 3)$ $I_D = 0.3(9 - 3)$ $I_D = 0.3(6) = 1.8A$	Formula selection = 1 Mark Substitution = 1 Mark Answer = 1 Mark	1	2	0	3	2
	b	$P = V \times I$ $V = \frac{P}{I}$ $V_S = \frac{108}{1.8} = 60V$	Formula selection & Rearrangement = 1 Mark Substitution – 1 Mark / Answer 1 Mark	1	2	0	3	2
		Question 9 total		2	4	0	6	4

Question			Marking details	Marks available																																																																				
				AO1	AO2	AO3	Total	Maths																																																																
10	a	(i)	Yellow output = $Q_0 + Q_3$ - 1 mark	0	2	0	2	2																																																																
		(ii)	Orange output = $\overline{Q_2 + Q_4}$ - 1 mark (Accept $\overline{Q_2} \cdot \overline{Q_4}$)																																																																					
	b		<table border="1" style="display: inline-table; margin-right: 20px;"> <thead> <tr> <th colspan="4">Light Outputs</th> </tr> <tr> <th>Pulse</th> <th>Yellow</th> <th>Pink</th> <th>Orange</th> </tr> </thead> <tbody> <tr><td>0</td><td>ON</td><td>ON</td><td>ON</td></tr> <tr><td>1</td><td>OFF</td><td>OFF</td><td>ON</td></tr> <tr><td>2</td><td>OFF</td><td>ON</td><td>OFF</td></tr> <tr><td>3</td><td>ON</td><td>ON</td><td>ON</td></tr> <tr><td>4</td><td>OFF</td><td>ON</td><td>OFF</td></tr> <tr><td>5</td><td>ON</td><td>ON</td><td>ON</td></tr> </tbody> </table> or <table border="1" style="display: inline-table; margin-left: 20px;"> <thead> <tr> <th colspan="4">Light outputs</th> </tr> <tr> <th>Pulse</th> <th>Yellow</th> <th>Pink</th> <th>Orange</th> </tr> </thead> <tbody> <tr><td>0</td><td>1</td><td>1</td><td>1</td></tr> <tr><td>1</td><td>0</td><td>0</td><td>1</td></tr> <tr><td>2</td><td>0</td><td>1</td><td>0</td></tr> <tr><td>3</td><td>1</td><td>1</td><td>1</td></tr> <tr><td>4</td><td>0</td><td>1</td><td>0</td></tr> <tr><td>5</td><td>1</td><td>1</td><td>1</td></tr> </tbody> </table> 1 mark for each correct Output Column	Light Outputs				Pulse	Yellow	Pink	Orange	0	ON	ON	ON	1	OFF	OFF	ON	2	OFF	ON	OFF	3	ON	ON	ON	4	OFF	ON	OFF	5	ON	ON	ON	Light outputs				Pulse	Yellow	Pink	Orange	0	1	1	1	1	0	0	1	2	0	1	0	3	1	1	1	4	0	1	0	5	1	1	1	0	3	0	3	0
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Question 10 Total				0	5	0	5	2																																																																
Paper Total				35	35	10	80	34																																																																