



GCSE MARKING SCHEME

SUMMER 2019

**ELECTRONICS - COMPONENT 2
C490U20-1**

INTRODUCTION

This marking scheme was used by WJEC for the 2019 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 – JUNE 2019
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.

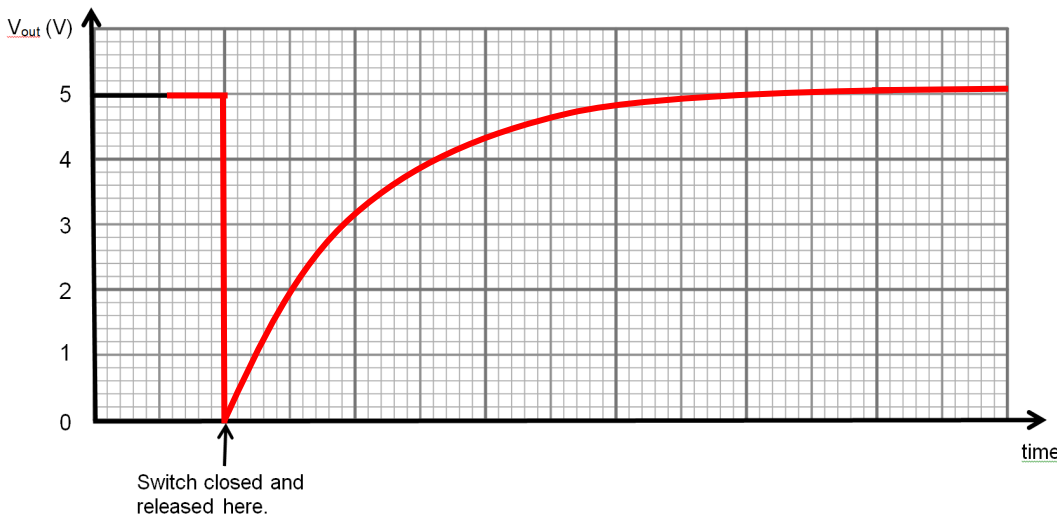
Marking abbreviations

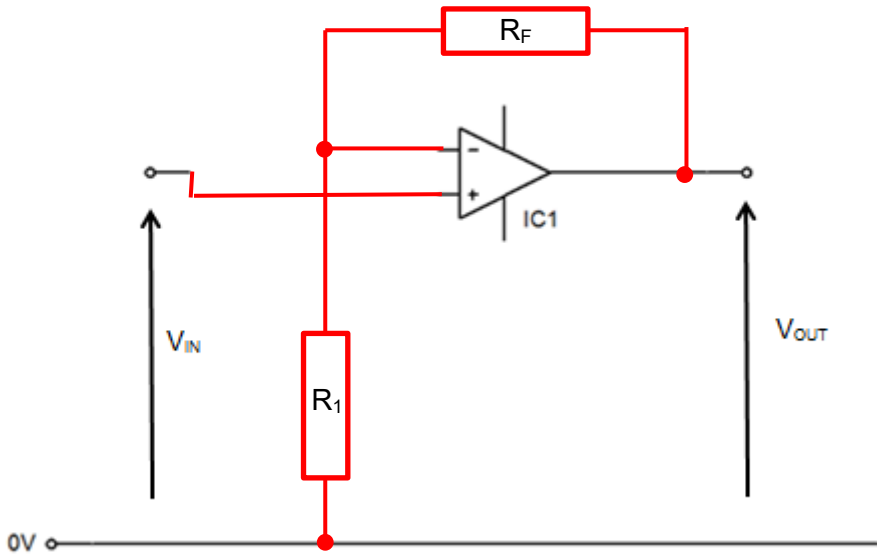
The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
ecf = error carried forward

Question		Marking details	Marks available				
			A01	A02	A03	Total	Maths
1	(a)	<pre> graph TD Start([Start]) --> Reset[Reset the counter] Reset --> D1{Has a can passed?} D1 -- NO --> Exit1[] D1 -- YES --> Add[Add 1 to 'count'] Add --> D2{Is count equal to 12?} D2 -- NO --> Exit2[] D2 -- YES --> Rest[Rest of programme] </pre> <p>1 mark for each correct box</p>	3			3	

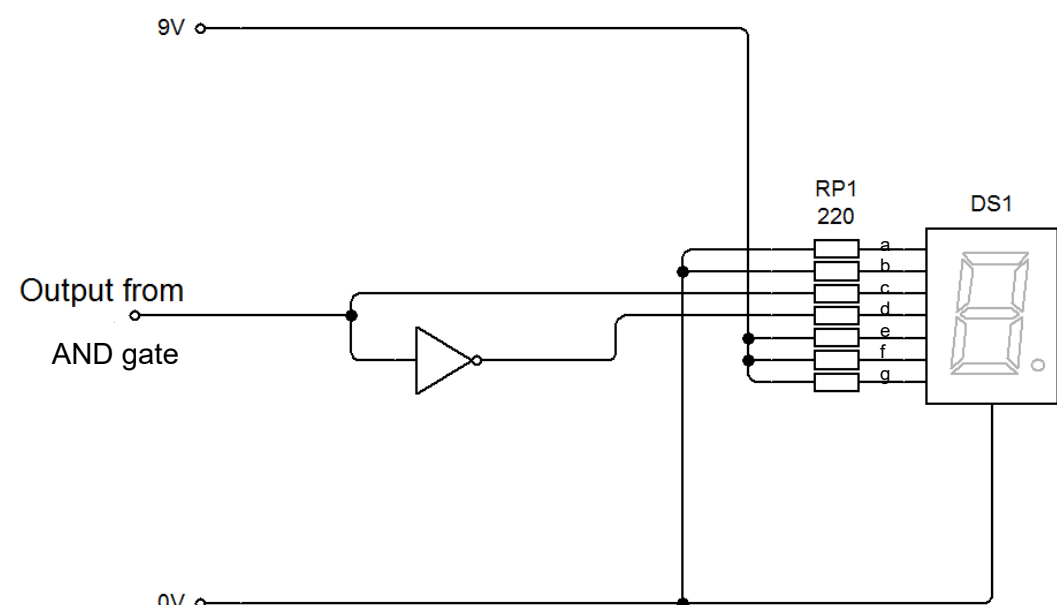
Question	Marking details	Marks available				
		AO1	AO2	AO3	Total	Maths
(b)	<pre> graph TD Start([Start]) --> Reset[Reset the counter] Reset --> D1{Has a can passed?} D1 -- YES --> Add[Add 1 to 'count'] Add --> D2{Is count equal to 12?} D2 -- YES --> Rest[Rest of programme] D1 -- NO --> D1 D2 -- NO --> D1 </pre> <p>1 mark for each correct link</p>	2	0	0	2	0
Question 1 Total		5	0	0	5	0

Question	Marking details	Marks available									
		AO1	AO2	AO3	Total	Maths					
2 (a)	 <p>Continuation of 5V to switch close position – (1) Instantaneous drop to 0V at switch close position – (1) Charging curve up to 5V over a period of time – (1)</p>	1	2		3						
(b)	i	$T = 1.1 \times R \times C \quad (1 \text{ selection})$ $R = \frac{T}{1.1 \times C} \quad (1 \text{ re-arrangement})$ $R = \frac{180}{1.1 \times 2200 \times 10^{-6}} \quad (1 \text{ substitution})$ $R = 74380.16\Omega \quad (1 \text{ answer})$					1	3		4	4
	ii	Use / Add a variable resistor and adjust this until the exact delay is achieved.					1	0		1	
Question 2 Total		3	5	0	8	4					

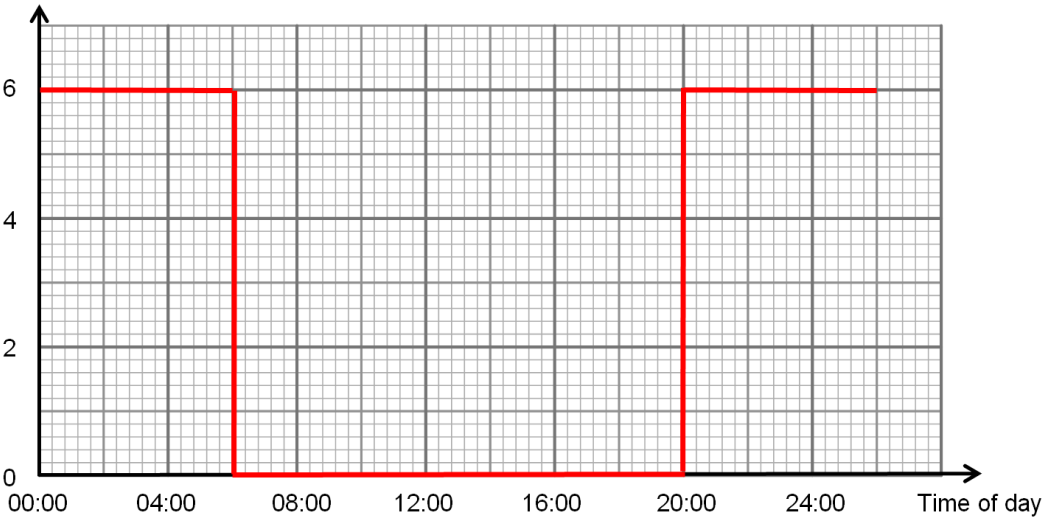
Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	
3	(a)	i	 <p> R_F from output to inverting input – (1) R_1 from inverting input to 0V – (1) V_{IN} to non-inverting input – (1) </p>						
		ii	$Gain = 1 + \frac{R_F}{R_1}$ $35 = 1 + \frac{R_F}{R_1} \text{ (Formula \& substitution - 1)}$ $35 - 1 = \frac{R_F}{R_1}$ $R_F = 34R_1 \text{ (Rearrange and correct ratio - 1)}$ $R_1 = 2k\Omega, R_F = 68k\Omega \text{ (Correct values } \geq 1k - 1)$	1	0	2	3	3	

Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
3	(b)	i	Sine wave with same frequency as V_{IN} – (1) Non – inverted - (1) Max amplitude at $\pm 10.5V$ – (1)	2	1		3	1
		ii	Output clipped at $\pm 13V$		1		1	1
			Question 3 Total	3	5	2	10	5

Question			Marking details						Marks available							
									AO1	AO2	AO3	Total	Maths			
4		i	Display Segments													
			Display	AND gate output	a	b	c	d						e	f	g
			h	1	0	0	1	0						1	1	1
			t	0	0	0	1	1						1	1	1
			1 mark for each correct row in table							2		2				

Question		Marking details	Marks available				
			AO1	AO2	AO3	Total	Maths
	ii	 <p>9V</p> <p>0V</p> <p>Output from AND gate</p> <p>RP1 220</p> <p>DS1</p> <p>a b c d e f g</p> <p>Inputs for segments 'a' & 'b' connected to 0V – 1</p> <p>Inputs for segments 'e', 'f' & 'g' connected to 9V – 1</p> <p>Input for segment 'c' connected to output from counter – 1</p> <p>Input for segments 'd' connected output from counter via NOT gate – 1</p>					
Question 4 Total			1	3	2	6	0

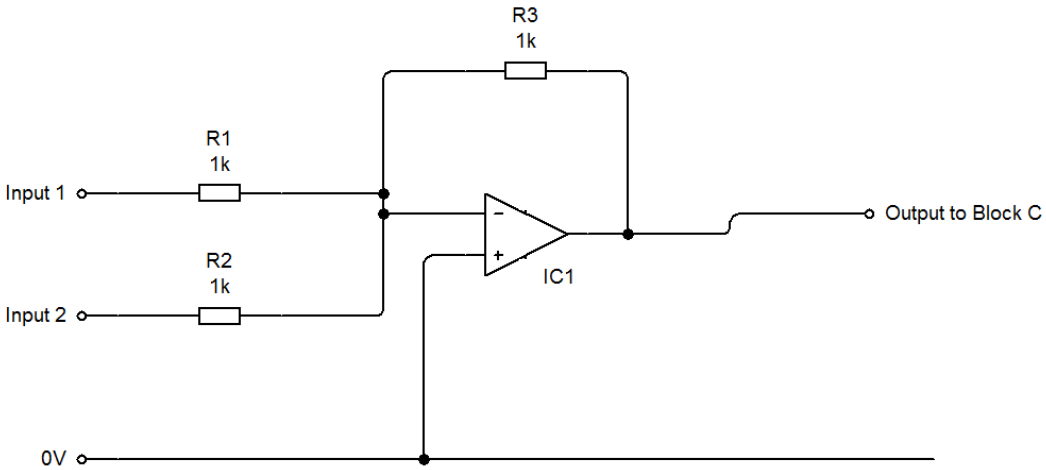
Question		Marking details			Marks available				Maths																																																																																																																			
					AO1	AO2	AO3	Total																																																																																																																				
5	(a)	i	Red = A + B				1		1	1																																																																																																																		
		ii	Yellow = $\bar{C} + D$				1		1	1																																																																																																																		
	(b)	i	Connection from Output B to one input of AND gate -1 Connection from Output D to the other input of AND gate - 1			2	0		2																																																																																																																			
		ii	<table border="1"> <thead> <tr> <th rowspan="2">Pulse number</th> <th colspan="4">Counter outputs</th> <th colspan="4">Outputs</th> </tr> <tr> <th>D</th> <th>C</th> <th>B</th> <th>A</th> <th>Red</th> <th>Blue</th> <th>Green</th> <th>Yellow</th> </tr> </thead> <tbody> <tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</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>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr> <tr><td>2</td><td>0</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td><td>1</td><td>1</td></tr> <tr><td>3</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</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><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><td>1</td><td>1</td><td>0</td><td>0</td></tr> <tr><td>6</td><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>7</td><td>0</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>8</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td></tr> <tr><td>9</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr> <tr><td>10</td><td>1</td><td>0</td><td>1</td><td>0</td><td colspan="4">Reset</td></tr> </tbody> </table> <p>1 mark for each correct column.</p>			Pulse number	Counter outputs				Outputs				D	C	B	A	Red	Blue	Green	Yellow	0	0	0	0	0	0	1	1	1	1	0	0	0	1	1	1	1	1	2	0	0	1	0	1	0	1	1	3	0	0	1	1	1	0	1	1	4	0	1	0	0	0	1	0	0	5	0	1	0	1	1	1	0	0	6	0	1	1	0	1	0	0	0	7	0	1	1	1	1	0	0	0	8	1	0	0	0	0	1	1	1	9	1	0	0	1	1	1	1	1	10	1	0	1	0	Reset				4		
Pulse number	Counter outputs				Outputs																																																																																																																							
	D	C	B	A	Red	Blue	Green	Yellow																																																																																																																				
0	0	0	0	0	0	1	1	1																																																																																																																				
1	0	0	0	1	1	1	1	1																																																																																																																				
2	0	0	1	0	1	0	1	1																																																																																																																				
3	0	0	1	1	1	0	1	1																																																																																																																				
4	0	1	0	0	0	1	0	0																																																																																																																				
5	0	1	0	1	1	1	0	0																																																																																																																				
6	0	1	1	0	1	0	0	0																																																																																																																				
7	0	1	1	1	1	0	0	0																																																																																																																				
8	1	0	0	0	0	1	1	1																																																																																																																				
9	1	0	0	1	1	1	1	1																																																																																																																				
10	1	0	1	0	Reset																																																																																																																							
		Question 5 Total			6	2	0	8	2																																																																																																																			

Question		Marking details	Marks available				Maths
			AO1	AO2	AO3	Total	
6	(a)	<p>The Schmitt trigger provides a fast changing output to drive the transducer driver rapidly from Off to On</p> <p>OR</p> <p>Provides a tolerance to shadows so prevents rapid switch on and off through slightly varying light levels. (1)</p>	1	0	0	1	
	(b)	<p>i</p>  <p>Correct orientation – 1 Correct saturation values – 1 Correct 1-0 transition – 1 Correct 0-1 transition – 1</p>	2	2	0	4	2
		<p>ii</p> <p>Lights OFF – 06:00 (6:00 a.m.) – 1 Lights ON – 20:00 (8.00 p.m.) – 1</p>		2		2	2
		Question 6 Totals	3	4	0	7	4

Question			Marking details	Marks available				
				AO1	AO2	AO3	Total	Maths
7	(a)	i	$\frac{T_{ON}}{T_{OFF}} = \frac{R_1+R_2}{R_1} \quad (\text{formula} = 1)$ $\frac{T_{ON}}{T_{OFF}} = \frac{10+47}{10} \quad (\text{equation and substitution} - 1)$ $\frac{T_{ON}}{T_{OFF}} = \frac{57}{10}$ $T_{ON} = 5.7T_{OFF} \quad (\text{Correct ratio} - 1)$	1	2		3	2
		ii	$f = \frac{1.44}{(R_1+2R_2) \times C} \quad (\text{formula} = 1)$ $f = \frac{1.44}{(47k + 2 \times 10k) \times 220\mu}$ $f = \frac{1.44}{(47 \times 10^3 + 2 \times 10 \times 10^3) \times 220 \times 10^{-6}} \quad (\text{substitution and multipliers} - 1)$ $f = \frac{1.44}{(67 \times 10^3) \times 220 \times 10^{-6}} = 0.0976 \cong 0.1Hz \quad (\text{answer} - 1)$	3			3	3

Question		Marking details				Marks available					
						AO1	AO2	AO3	Total	Maths	
(b)	i	Decade Counter Outputs	Red	Yellow	Green	Blue					
		0	1	0	0	0					
		1	0	1	0	0					
		2	0	0	0	1					
		3	1	0	0	0					
		4	0	0	0	1					
		5	0	1	0	0					
		6	0	0	1	0					
		7	RESET								
		8									
		9									
				1 mark for each correct column				4			4

Question		Marking details	Marks available				
			AO1	AO2	AO3	Total	Maths
(b)	ii	<p>1 mark for each correctly configured output x 4</p>		4		4	
	iii	$f = \frac{1}{T} \quad (\text{Formula} - 1)$ $T = \frac{1}{f} \quad (\text{Rearrangement} - 1)$ $T = \frac{1}{0.1} = 10 \quad (\text{Substitution \& Answer} - 1)$ <p>Blue on for 2 clock pulses = 2 x 10 = 20s (Final answer – 1)</p>	1	3		4	4
		Question 7 Total	9	9	0	18	9

Question		Marking details	Marks available				
			AO1	AO2	AO3	Total	Maths
8	(a)	A – Preamplifier – 1 B – Mixer - 1 C – Power Amplifier – 1	3				
	(b)	 <p>Non-inverting input connected to 0V – 1 RF Connected between output and inverting input – 1 Input 1 connected via resistor to inverting input – 1 Input 2 connected via resistor to inverting input – 1</p>		2	2		
	(c)	Block C takes the mixed output signal and either increases the current or power needed to drive the loudspeaker.		1			
		Question 8 total	3	3	2	8	

Question		Marking details	Marks available				
			AO1	AO2	AO3	Total	Maths
9	(a)	<p>Indicative Content:</p> <p>The design as presented has a couple of issues. Firstly, the heater should switch on when either the temperature falls below 25°C OR a switch is pressed. The design incorporates an AND gate which will not meet the requirement of the specification and needs to be changed for an OR gate.</p> <p>The switch SW1 is correctly orientated to provide a logic 1 input at A when pressed as the resistor acts as a pull-down resistor holding input A at logic 0 until the switch is pressed as per the specification.</p> <p>The thermistor however is incorrectly placed as it should be connected between B and the 0V line to provide the logic 1 signal required when the temperature is below 25°C as the resistance of the thermistor increases when the temperature falls.</p> <p>The MOSFET and heater are correctly positioned.</p> <p>5-6 marks</p> <p>Candidates have evaluated the specification fully e.g. all three statements considered against the given circuit, justifying placement 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</p> <p>Candidates have evaluated most of the specification e.g. two of the three statements with the given circuit, justification of placement 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>	0	2	4	6	

Question	Marking details	Marks available				Maths
		AO1	AO2	AO3	Total	
	<p>1-2 marks Candidates have evaluated little of the specification e.g. one of the three statements with the given circuit, justification of placement 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>					
(b)	$I_D = g_M(V_{GS} - 3) \quad (1 - \text{equation})$ $(V_{GS} - 3) = \frac{I_D}{g_M}$ $V_{GS} = \frac{I_D}{g_M} + 3 \quad (1 - \text{rearrangement})$ $V_{GS} = \frac{4}{0.8} + 3 \quad (1 - \text{substitution})$ $V_{GS} = 8V \quad (1 - \text{answer})$	2	2		4	3
	Question 9 total	2	4	4	10	3
	TOTAL	35	35	10	80	24