



GCE AS MARKING SCHEME

SUMMER 2022

A LEVEL ELECTRONICS – COMPONENT 1 A490U10-1

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INTRODUCTION

This marking scheme was used by WJEC for the 2022 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.

EDUQAS A LEVEL ELECTRONICS – COMPONENT 1

PRINCIPLES OF ELECTRONICS

SUMMER 2022 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 dataila		Ма	rks availa	able	
Question	Marking details	A01	AO2	AO3	Total	Maths
1. (a) (i) (ii)	$ \frac{\overline{C} \overline{B} \overline{A} \overline{Q}}{0 0 1 1} \\ \frac{\overline{O} 0 0 1 1}{0 1 1} \\ \frac{\overline{O} 1 0 1}{1 0 1} \\ \frac{\overline{O} 1 1 1}{1 0 1} \\ \frac{\overline{O} 1 1 1}{1 1 0} \\ \frac{\overline{O} 1 1 1}{1 1} \\ \frac{\overline{O} 1 1 1}{1 1} \\ \frac{\overline{O} 1}{1} \\ \frac{\overline{O} 1}{1} \\ \overline{O$	AO1 1	AO2	AO3	Total	Maths
(iii)	OR gate equivalent (1) A = 0 + 0 + 0 + 0 + 0 + 0 + 0 + 0 + 0 + 0		2		3	

uestion					Marki		Marks available				
uestic	n				WIATKI	ig details	AO1	AO2	AO3	Total	Math
	(iv)	Fewer IC:	s needed	I			1				
		In first cire other sen	sible ans	s required wer]	d, in NAN	D circuit only 1 IC required. [Accept any	1			2	
(b)	(i)	Ŝ	R	0	ō		/				
		1	1	1	0						
		1	0	0	1						
		1	1	0	1						
		0	1	1	0			3			
		1	1	1	0						
		0	0	1	1						
		Lines 2 au Lines 3 au Line 6 (1)	nd 4 (1) nd 5 (1)	1	1					3	
	(ii)	Disallowe Or/ Q can cha	d state ange at a	iny time.			1			1	
	(iii)	Alarm/me	mory					1		1	
		Question	1 total		/		4	9	0	13	0

	uostic	.	Marking datails		Ма	rks availa	able	
	uestic			AO1	Marks available AO1 AO2 AO3 Total 1 1 1 1 1 1		Maths	
2.	(a)	(i)	A	1			1	
		(ii)	0	1			1	
	(b)		$\overline{\overline{A.B.C}}, \overline{\overline{A.B}} = (1)$ $A.B.\overline{C}, (\overline{A} + B) = (1)$ $A.B.\overline{C}, \overline{A} + A.B.\overline{C}, B = (1)$ $A.B.\overline{C} = (1)$ Alternative answer: $\overline{\overline{A.B.C} + A.\overline{B}} = \overline{\overline{A} + \overline{B} + \overline{C} + A.\overline{B}} = (1)$ $= \overline{\overline{A}}, \overline{\overline{B}}, \overline{\overline{C}}, \overline{\overline{A.B}} = \overline{\overline{A} + \overline{B} + \overline{C} + A.\overline{B}} = (1)$ $= \overline{A}, \overline{B}, \overline{C}, (\overline{A} + \overline{B}) = (1)$ $= A.B.\overline{C}, (\overline{A} + A.B.\overline{C}, B) = (1)$ $= 0 + A.B.\overline{C} = A.B.\overline{C} = (1)$		4		4	4

Question	Marking dotails		Ма	rks availa	ble	
Question		AO1	AO2	AO3	Total	Maths
(C)	$\begin{array}{c} \begin{array}{c} & & & \\ & & & \\ D.C & & & \\ \hline 0 & & & \\ \hline 0 & & & \\ 1 & & & \\ 1 & & \\ 1 & & \\ 1 & & \\ 1 & & \\ 1 & & \\ 1 & & \\ 1 & & \\ 1 & & \\ 1 & & \\ 1 & & \\ 0 & & \\ 1 & & \\ 1 & & \\ 0 & & \\ 1 & & \\ 1 & & \\ 0 & & \\ 1 & & \\ 1 & & \\ 0 & & \\ 1 & & \\ 1 & & \\ 0 & & \\ 1 & & \\ 1 & & \\ 1 & & \\ 0 & & \\ 1 & $		3		3	3
	Question 2 total	2	7	0	9	7

0	unctio	n					M	arkin	a dot		Ма	Marks available AO2 AO3 Total Maths 4				
<u>u</u>	uestio						IVI		y uel	AO1	AO2	AO3	Total	Maths		
3.	(a)		C 0 0 0 1 1 1 1 1 1	B 0 1 1 0 0 1 1 1 5 5 6 7 8 6 7 8 8	A 0 1 0 1 0 1 0 1 0 1 0 0	L 1 0 0 1 1 1 0 0 0	M 1 0 1 1 1 0 1 1 1 1 L, M,	N 1 0 0 1 1 1 1 1 1 N, Q	Q 1 0 0 1 1 1 1 (ecf)		4					
	(b)		$\overline{C}.\overline{B}.\overline{A}$ Any or All fou ecf (a)	+ C. <u>B</u> ne term r terms	. Ā + 0 n (1) s (2)	C. B. Ā	+ C.B	8. A			2		4			
			Quest	ion 3 t	total					0	6	0	6	0		

	uootio		Marking dataila		Ма	rks availa	ıble	
	uestic	n	Marking details	AO1	AO2	AO3	Total	Maths
4.	(a)	(i)	Number of revolutions = $200/50 = 4 \text{ rev} (1)$ Rotational speed = $2 \times 4 = 8 \text{ rpm} (1)$		2		2	2
		(ii)	Number of slots = $20 \times 50 = 1000$ (1)		1		1	1
		(iii)	$ \begin{array}{l} R = V/I = 5 - 2.1/20 \ x \ 10^{-3} \ (1) \\ R = 145 \ \Omega \ (1) \end{array} $		2		2	2
		(iv)	When illuminated a current flows through the photodiode (1) The base current increases and the transistor conducts (1) The voltage at the collector drops to nearly 0V (1) (or equivalent answer)	2	1		3	
	(b)		Make signal sharper/clean up signal/digitise (1)	1				
	()						1	
			Question 4 total	3	6	0	9	5

	uastia	n	Marking dataila		Ма	rks availa	ble	
Q	uestio	n	Marking details	A01	AO2	AO3	Total	Maths
5.	(a)	(i)	$V_{IN} = 0.6 V$		1		1	1
		(ii)	Values read from graph correctly (1) Gain = 10/0.5 = 20 (1)	1	1		2	2
		(iii)	$\begin{array}{c} & & \\ \hline \\ \hline$			4	4	
	(b)	(i)	Gain 41 41 39 28.4 19.8 12.4 10.4	1			1	1

0	unstion	Marking dataila		Ма	rks availa	able	
Q	uestion		AO1	AO2	AO3	Total	Maths
	(ii)	Graph: All plots correct (1) Line: Correct shape, smooth line. (1)	1	1		2	2
	(iii)	Gain 41 (1) Is within tolerance of 40 +/- 2 (1) Correct use of graph to find the bandwidth (1) Bandwidth = 8 kHz +/- 0.2 (1) Is outside of specification of 10 +/- 1 kHz (1)	1		4	5	
		Question 5 total	4	3	8	15	6

	Questie		Merking details		Ма	rks availa	ble	
,	Questio	n	Marking details	AO1	AO2	AO3	Total	Maths
6.	(a)	(i)	High pass filter (Bass cut) (1)	1			1	
		(ii)	$f_b = 1/2\pi RC = 1/2\pi (9.4 \times 10^{-9} \times 6.2 \times 10^3) = 2.73 \text{ kHz}$					
			Multipliers (1)	3				
			Answer (1)				3	2
	(b)	(i)	Use of $X_c = 1/2\pi fC$ with correct substitutions (1)	1				
			At 200 Hz 84.7 k Ω and at 20kHz 847 Ω (1 + 1)		2		3	3
		(ii)	Use of $V_{OUT} = R \times V_{IN}/\sqrt{(R^2 + Xc^2)}$ (1) with correct substitutions (1)	1 1				
			to calculate: V_{OUT} at 200Hz = 0.73 V (1)		1		3	3
		(iii)	$V_{OUT} = 0.707 \times 10 (accept 0.7) (1)$					
			= 7.07 V(1)		2		2	2
	(c)		VcorfV • VcorfV • 10 - 10 - 7.07 -					
			2.73 Frequency/kHz	1				
			Shape of line (1)		2			
			Break frequency labelled (1)		<u> </u>			
			Allow ecf from (a)(i),(ii) and (b)(iii)				3	
			Question 6 total	8	7	0	15	10

Overtien	Marking dataila	Marks available				
Question	Marking details	AO1	AO2	AO3	Total	Maths
7.	$\begin{array}{c} 4 \lor \\ \hline \\ R \\ \hline$			5	5	
	Question 7 total	0	0	5	5	0

A01 A02 A03	Total	Maths
8. (a) Diode connected across solenoid with correct orientation (1) 1	1	
(b) (i) $I_c = 9/15 = 0.6 A (1)$ Use of $I_b = I_c/h_{FE}$ with correct substitutions (1) 2 = 5 mA (1) 2	3	2
(ii) $R_B = V_1 - 0.7/I_b (1)$ = 6.4 - 0.7/5x10 ⁻³ = 1.14 k Ω (1) Select 1.1 k Ω (1) ecf from calculation 2	3	2
(c) $\begin{pmatrix} c \\ s \\ c \\$	3	
(d) (i) Read off V _{CE} correctly as 3.0 V (allow +/- 0.2 V) (1) 1	1	
(ii) $V_{SOL}= 9.0 - 3.0 = 6.0 V (1)$ IB = VIN - 0.7/RB = 4.5 - 0.7/1.14k (1) 1 Use of Ic = V_{SOL}/R_{SOL} or = 3.3 mA (1) 1 with correct substitutions (1)		
= 0.4 A (1) IC = hFE x IB = 120 x $3.3m = 0.4 A (1)PTr = VCE x IC = 3.0 \times 0.4 (1) = 1.2 W (1)Allow ecf 1 2$	5	Λ
Question 8 total 9 7 0	16	8

	waatia		Marking dataila		Ма	arks availa	able	
Q	uestio	n	Marking details	AO1	AO2	AO3	Total	Maths
9.	(a)	(i)	T = 160 μ s from graph (1) (Tolerance ±5; range 155 to 165 μ s) Use of f=1/T with substitution (1) To calculate f = 6250 Hz or 6.25 kHz (1) (Tolerance ±200 Hz; range 6050 to 6450 Hz)	1	1 1		3	2
		(ii)	Using m = $\frac{(V_{max} - V_{min})}{(V_{max} + V_{min})} \times 100\%$ (1) m = $\frac{(1.5 - 0.5)}{(1.5 + 0.5)} \times 100\%$ (1)		2			
			m = 50% +/- 10%	1			3	2
	(b)	(i)	585 kHz	1			1	
		(ii)	593 -577 16 kHz (1)		1		1	
	(c)	(i)	Several independent users can send signals at once (1) Each signal is assigned a frequency and range (1) (accept a graphical answer)	2			2	
		(ii)	Number of stations = $(1605 - 535)/16 = 66.88(1)$ Therefore 66 stations. (1) Allow ecf from (b)		2		2	1
	(d)	(i)	The voltage of the audio signal changes the frequency of the carrier wave. (1) The frequency of the audio signal is modulated as the rate of change of	1 1			_	
		(ii)	Less susceptible to noise in transmission (1) Due to no information carried in the amplitude (1)	2			2	

0	uastia	•	Marking dataila		Marks available			
Q	uestion	1		AO1	AO2	AO3	Total	Maths
		(iii)	I Use of $\beta = \Delta f_o/f_i = 40$ KHz/10KHz (1) B = 4 (1) II Use of Bandwidth = 2(1 + β) f_i (1) Bandwidth = 100 kHz (1) or alternative method, ecf I	1	1		4	2
			Question 9 total	11	9	0	20	7

	uosti	20	Marking datails		Ма	arks availa	able	e	
ų	uesii	חכ		AO1	AO2	AO3	Total	Maths	
10.	(a)	(i)	Light sensor to Non-inverting input (1) Resistor chain connected to inverting input (1) $R_1:R_2 = 2:1$ (1)	2	1				
							3		
	(b)	(i)	Use of: $I_D = g_M(V_{GS} - 3)$ (1) Rearranged to $g_M = I_D/(V_{GS} - 3) = 5/(11-3)$ (1) $g_M = 0.625$ S (1)	1	2		3	2	
		(ii)	Use of: $P = I^2 R_{DSon} = 5^2 \times 0.2$ (1) P = 5.0 W (1)	1	1		2		
			Question 10 total	4	4	0	8	2	

Question		Marking dataila		Marks available				
		Marking details	AO1	A01 A02 A03		Total	Maths	
11.	(a)	Indicative content:						
		Evaluation:						
		Calculation of the gain using $G = -R_F/R_{IN} = -50$ This meets the first parameter						
		The input impedance is $R_{IN} = 10 k\Omega$ so doesn't meet the second parameter.						
		Bandwidth calculated from $BW = GBP/G = 20 \text{ kHz}$ This meets/exceeds the third parameter.						
		Output will saturate with an input voltage of 200 mV so any input voltage above 200 mV will be distorted. This doesn't meet the fourth parameter.	1		5			
		Changes to be made:						
		The input resistor should be changed to $12 k\Omega$ to meet the second parameter but then the value of R_F must be changed to $600 k\Omega$ to maintain a gain of -50.						
		The power supply should be increased so that saturation will occur at more than 12.5V thus allowing an input voltage of 250mV to remain undistorted.				6	2	
	11		I			I		

Question	Marking dataila		Ма	rks availa	able	
Question		AO1	AO2	AO3	Total	Maths
	 5-6 marks The answer evaluates all four parameters. Calculations are shown and related to the specification. All alterations to the circuit are given. 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. 3-4 marks The answer evaluates two of the parameters. Calculations are shown and related to the specification. Two alterations to the circuit are given. 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 The answer evaluates one of the parameters. A calculation is shown and related to the specification. One alteration to the circuit is given. 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. 1-2 marks No attempt made or no response worthy of credit.	A01	AO2	A03	Total	Maths

unation	Marking dataila		Ма	irks availa	able		
uestion	Marking details AO1 AO2		AO3	Total	Maths		
(b) (i)	Select and rearrange: $\Delta t = \Delta V_{OUT}$ /slew rate (1) $\Delta t = 20 \mu s$ (1)	1	1				
	Correct shape (1)		1				
(ii)	Slew rate = $2\pi fV_p$ f = 0.5 x 10 ⁶ / 2π (200x10 ⁻³ x 50) select and rearrangement (1) use of 200x10 ⁻³ x 50 (1) use of 0.5 x 10 ⁶ (1) f = 7960 Hz (1) Accept 7.96 kHz	1	3		4	3	
		-		-	4	3	

	Vuoction	Marking dataila	Marking details Marks available				
	uestion	iniarking details		AO2	AO3	Total	Maths
12.	(a)	Amplitude of signal is reduced as it travels through the wire (1) Frequency is unchanged (1)	2			2	
	(b)	Power loss = $12 \times (-)1.8 = (-)21.6 dB (1)$ Overall loss = $(2 \times 10) - 21.6 = (-)1.6 dB (1)$ $-1.6 = 10 \log_{10}(5 \times 10^{-9}/P_{in})$ (1) $P_{IN} = 5 \times 10^{-9}/10^{-0.16}$ (1) $P_{IN} = 7.2 nW (1)$	1	1 3			4
						5	
	(c)	Output signal = $32.8 - 0.420 = 32.38 \vee (1)$ SNR = $20 \log_{10} (32.38/0.420) (1)$ SNR = $37.7 dB (1)$	1	1			3
						3	
		Question 12 total	4	6	0	10	7
	· •	TOTAL	52	70	18	140	60

COMPONENT 1

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

QUESTION	AO1	AO2	AO3	TOTAL MARK	MATHS
1	4	9	0	13	0
2	2	7	0	9	7
3	0	6	0	6	0
4	3	6	0	9	5
5	4	3	8	15	6
6	8	7	0	15	10
7	0	0	5	5	0
8	9	7	0	16	8
9	11	9	0	20	7
10	4	4	0	8	2
11	3	6	5	14	8
12	4	6	0	10	7
TOTAL	52	70	18	140	60
		/			

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