

General Certificate of Secondary Education 2013

Technology and Design

Unit 2:

Systems and Control

Element 1: Electronic and Microelectronic Control Systems



[GTD21]

GTD21

FRIDAY 7 JUNE, AFTERNOON

TIME

1 hour.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

Write your answers in the spaces provided in this question paper.

Complete in blue or black ink only. Do not write in pencil or with a gel pen.

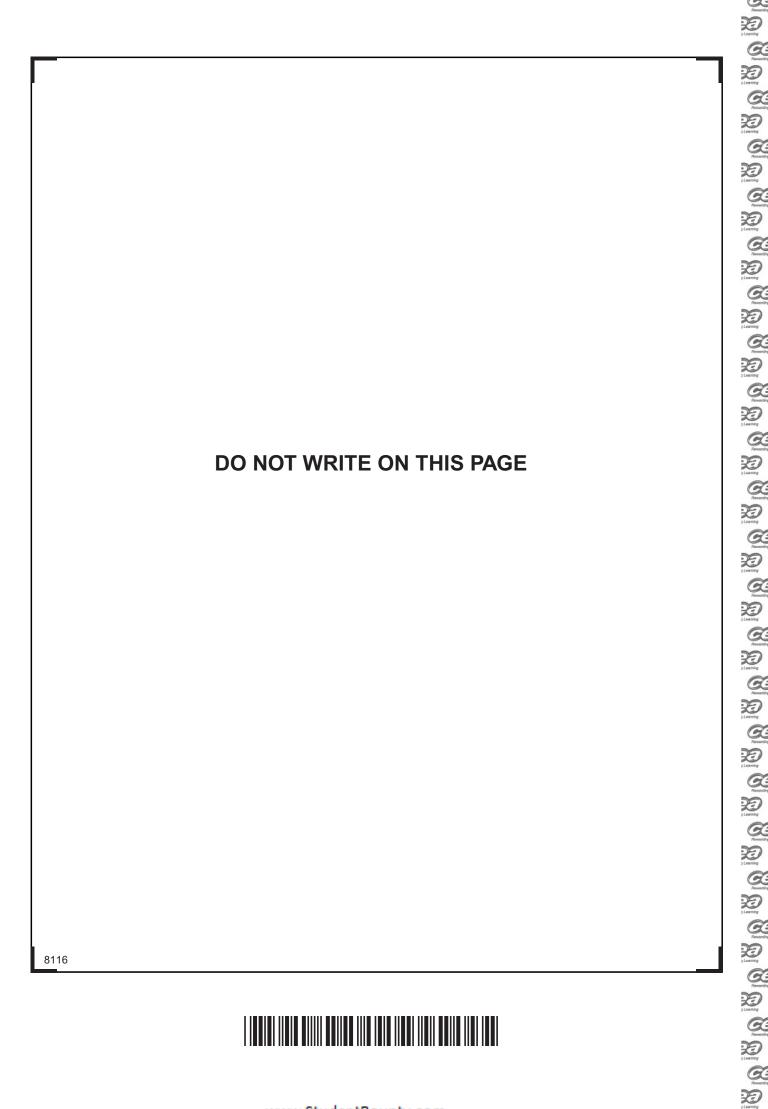
Answer all questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 80.

Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.



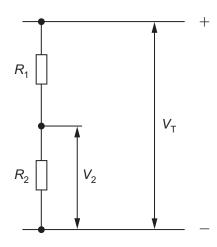


Formulae for GCSE Technology and Design

You should use, where appropriate, the formulae given below when answering questions which include calculations.

- 1 Potential Difference = current \times resistance ($V = I \times R$)
- 2 For potential divider

$$V_2 = \frac{R_2}{R_1 + R_2} \times V_T$$



3 Series Resistors
$$R_{T} = R_{1} + R_{2} + R_{3}$$
 etc

Parallel Resistors
$$\frac{1}{R_{\rm T}} = \frac{1}{R_{\rm 1}} + \frac{1}{R_{\rm 2}}$$
 or $R_{\rm T} = \frac{R_{\rm 1} \times R_{\rm 2}}{R_{\rm 1} + R_{\rm 2}}$

4 Time Constant
$$T = R \times C$$

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	(i)		[1]	Examiner Only Marks Remark
	(ii)	Name the components shown by their electronic symbols A and		
		in Fig. 1 .		
		A		
		B	[1]	
	(iii)	What type of switch is shown at C in Fig. 1 ?		
			[1]	
	(iv)	With reference to the labelled components A, B and C in Fig. 1 explain how an output at point X is achieved.		
		explain now an output at point X is achieved.		
			[4]	
(c)		e circuit in Fig. 1 is to be developed by including a resistor and a D between the 9V and 0V rails at points D and E .		
	(i)	Show this addition to the circuit in Fig. 1.	[4]	
	(ii)	With reference to the labelled component C explain how the additional parts will function in the circuit.		
			[4]	
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	(iii)	What purpose will this additional part of the circuit serve?	Examiner Only Marks Remark
		[1]	
	(iv)	If the LED used is rated at 2V, 6mA calculate in the space below the minimum value that should be used for the resistor.	
		[4]	
(d)		urther development in the circuit is to add an NPN transistor to erate a relay when required.	
	(i)	Develop the circuit in Fig. 1 by adding the NPN transistor and relay coil to enable this operation. Include any additional components that may be required. Neatly label the relay coil. [7]	
	(ii)	In the space below state the names of any additional components used and the reason for their use in the circuit.	
		[4]	
	(iii)	Outline one possible use for the relay in this circuit.	Total Question 1
		[1]	
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2	Fig	2 shows a circuit board with a microcontroller circuit.		Examin Marks	er Only Remark	
		Fig. 2				
		© New Wave Concepts Ltd				
	(a)	Suggest a method of modelling an electronic circuit.				
			[1]			
	(b)	Suggest a benefit of using this method of modelling.				
			[2]			•
	(c)	Analogue and digital inputs are used in microcontroller circuits. They are usually defined by how they function within a circuit. Outline the difference between a digital and analogue input signal.				
			[2]			
I				[Turi	n over	

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Examiner Only (d) Complete **Table 1** to identify if the component is a digital or an Marks Remark analogue component. Table 1 Component Digital/Analogue 7 Segment Display Toggle Switch **LDR** Reed Switch [4] (e) Part of a basic PIC microcontroller circuit is shown in Fig. 3. Insert on the part completed circuit in **Fig. 3**; the symbols for a $10 \, k\Omega$ resistor at point A, an LDR at point B, a toggle switch at point C and a $1 \, k\Omega$ resistor at point **D**. +6V O Α PIC B D 0 V O [4] Fig. 3 8116

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(f) A student is to design an electronic circuit for a rotating night-light using a PIC microprocessor. The night light is to operate automatically once the toggle switch is turned on. An LDR will act as a sensor to determine when the room becomes dark. The PIC microprocessor will control a motor and some LEDs.

The PIC has 2 inputs and 5 outputs.

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The inputs and outputs are shown in Tables 2 and 3.

When the room is dark the LDR input will be high.

Binary 1 indicates high (on) and binary 0 indicates low (off).

Digital Panels

Table 2

BIT	1	0	
PIC Input	Toggle Switch	LDR	

Table 3

BIT	4	3	2	1	0
PIC OUTPUT	Motor	Blue LED	Green LED	Yellow LED	Red LED

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Examiner Only

Marks Remark



Complete a series of flowcharts to represent the operating routines as follows:

(i) Complete a flowchart and its relevant bit patterns in Fig. 4 to represent the LIGHTS macro as follows:

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Marks Remark

The red and yellow LEDs must turn on for 6 seconds. Two seconds after the red and yellow LEDs turn on the green and blue LEDs should turn on for 4 seconds. All LEDs should then switch off. After a delay of 2 seconds all LEDs should switch on and remain on for 10 seconds before they all switch off. The macro will

LIGHTS		BIT PATTERN

Fig. 4



MOTOR LIGHTS	BIT PATTE	ERN
		[6]
	Fig. 5	

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(iii) Use Fig. 6 to complete the flowchart for the full operation of the night light.	Examine Marks	er Only Remark
Once the toggle switch is turned ON and the room has become dark, the following sequence should happen:		
 The motor should turn ON for 25 seconds The LIGHTS macro should operate 20 times The MOTOR LIGHTS macro should operate The sequence should repeat as long as the room remains in darkness 		

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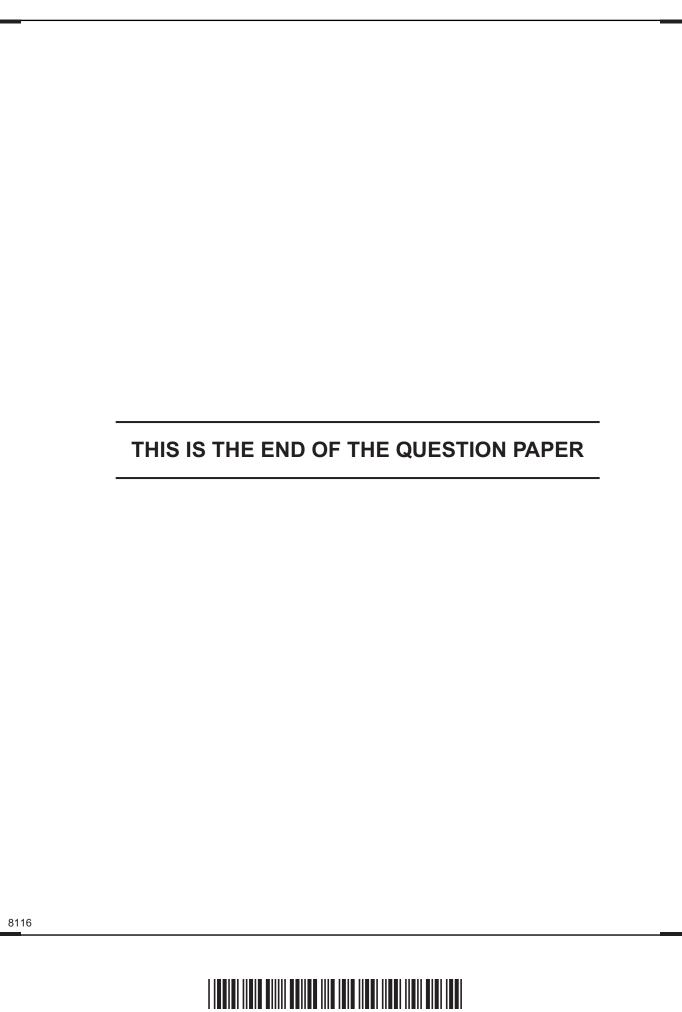
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				[12]	Total Qu	estion 2
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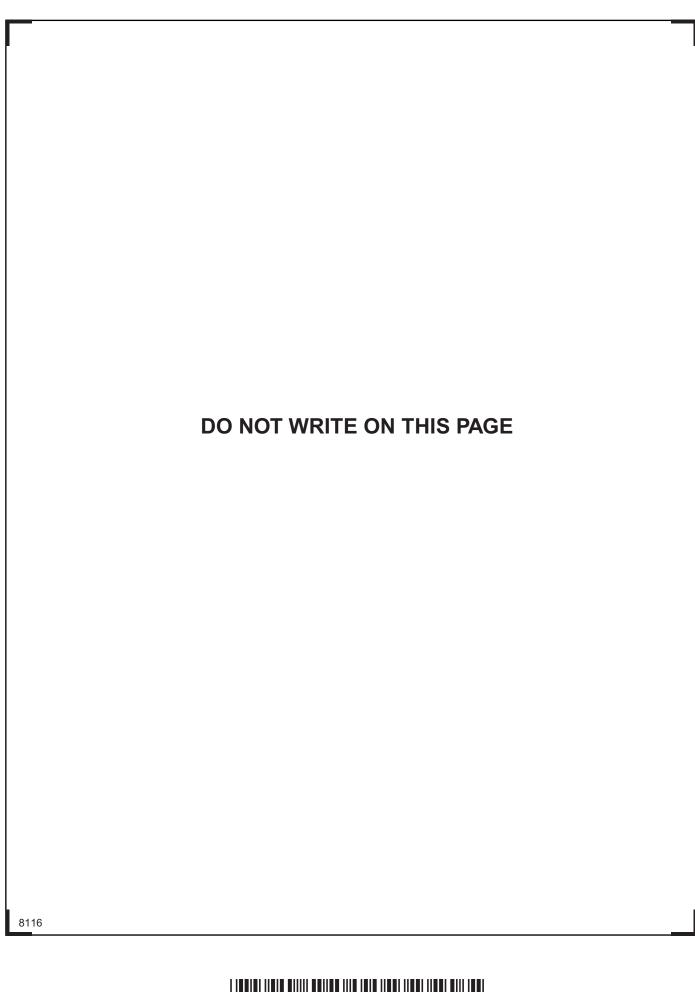


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