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Centre Number	5
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Candidate Number	13

Candidate Number					

General Certificate of Secondary Education 2014

Technology and Design

Unit 2:

Systems and Control

Element 1: Electronic and Microelectronic Control Systems

[GTD21] *GTD21*

TUESDAY 3 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.

Questions which require drawing or sketching should be completed using an HB pencil. All other questions must be completed in blue or black ink only. **Do**

not write in pencil or gel pen.

Answer all questions.

INFORMATION FOR CANDIDATES

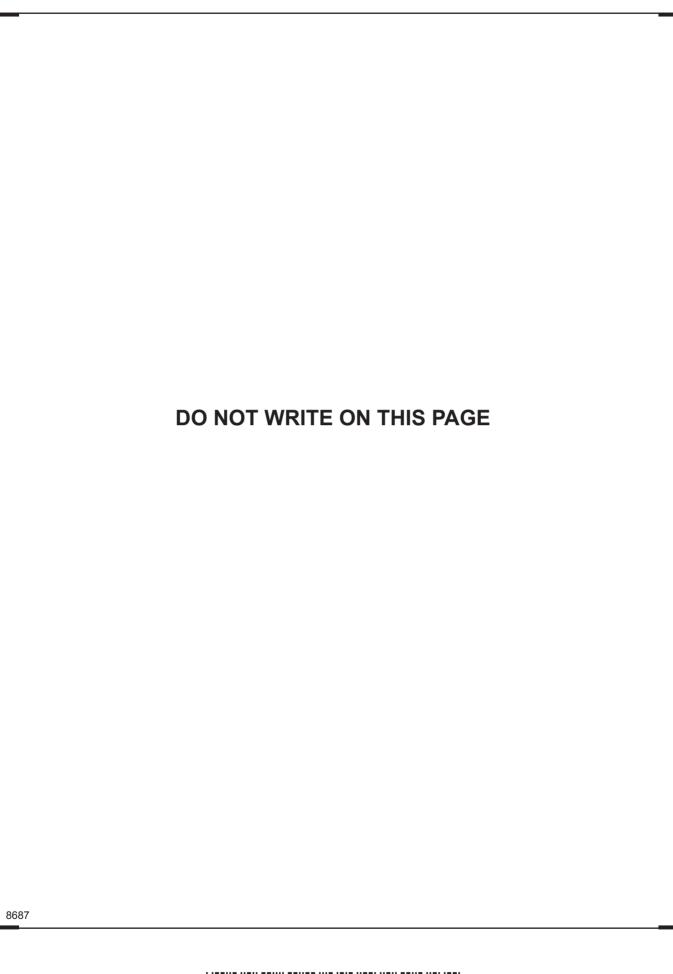
The total mark for this paper is 80.

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

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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

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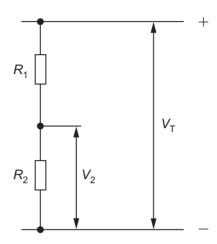
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$$V_2 = \frac{R_2}{R_1 + R_2} \times V_{\mathsf{T}}$$



3 Series Resistors $R_{\rm T} = R_{\rm 1} + R_{\rm 2} + R_{\rm 3}$ 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 $T = R \times C$

[Turn over



		Answer all questions.		Examine	
1	(a)	With reference to integrated circuits what does DIL mean? Explain with the aid of a sketch how pin one can be identified.		Marks I	Remark
		DIL	[1]		
		Sketch			
		Identity of pin one			
			[2]		
	(b)	(i) Calculate the value of the single resistor which could replace the three resistors shown in Fig. 1 below.	9		
		$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			
		Fig. 1			
	C	Calculation			
			[2]		
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Researching Learning DE GG Learning Researching COE	(ii) Using the colour code below identify the colour of the first three bands of the 6.8 kΩ resistor shown in Fig. 1 .	Examiner Only Marks Remark
Researcing Learning DO GG Learning Researcing Researcing Learning	0 = Black 1 = Brown 2 = Red 3 = Orange 4 = Yellow 5 = Green 6 = Blue 7 = Violet 8 = Grey 9 = White	
PLEATING REMARKS	Colour of Band 1	
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Reventing Learning Do GE 1 Learning Reventing I	Colour of Band 3 [3]	
Researching Learning Day GCC Pleasarching Researching 1	(iii) Calculate the combined value of the two resistors shown in Fig. 2 below. Each resistor has a value of 6.8 kΩ.	
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Researching Learning Researching I Researching I Researching Learning	(iv) Calculate the maximum and minimum values that the $6.8\mathrm{k}\Omega$ resistor may have if it has a 5% tolerance.	
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(V)	Complete the sentence b	Delow by inserting the missing words. Exam Marks
	The resistors in Fig. 1 are	e said to be connected in
	while the resistors in Fig.	. 2 are said to be connected in
	·	[2]
	e potential divider circuit in ential divider circuit showr	Fig. 3 is often used in preference to the in Fig. 4.
_		
	Fig. 3	Fig. 4
use	d explain why the potential	the two potential divider circuits shown divider circuit shown in Fig. 3 would be ential divider circuit shown in Fig. 4 .
Exp	blanation	
		[2]

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			[2]	
	(ii)	Does the circuit in Fig. 5 produce a monostable or an astable output?		
			[2]	
		Monostable output		
	(i)	Explain what an astable output is and what a monostable output is. Astable output	ut 	
	(:\	Fig. 5		
) V O			—0	
	H	1 5		
		7 8 4 7 6 3		
9V O			—0	
	Fig out	ential divider circuits form part of timing circuits as shown in . 5 . A timing circuit produces either an astable or monostable put.		Examiner Only Marks Rema

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(iii)	Name the integrated circuit (IC) component used in the circuit to provide the output.	Examiner Marks I
	[1]	
(iv)	Outline what is meant by the term time constant.	
	[2]	
(v)	Use the capital letters A and B to clearly mark on Fig. 5 the two components used to provide the time constant. [2]	
(vi)	Name the two components used in the circuit to provide the time constant.	
	[2]	
(vii)	Outline how the time constant in this circuit can be changed.	
	[2]	
(viii)	An LED is to be fitted in the circuit to indicate when the output is high. Complete the circuit in Fig. 5 so that the LED will operate as described. [6]	

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Researching Learning Researching Researching Researching Researching	The incomplete circuit diagram in Fig. 6 shows part of a primary PIC circuit and a secondary circuit. The secondary circuit requires a 12 volt supply	t
DO GG 1 Learning Researching 1 GOOD Researching Learning	and a 12 volt motor.	
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Theoretic Personality COD Researching Learning COD Researching Learning		
Researching Learning DO GG J. Learning Reventing I	12 volt supply and a motor in the correct locations. [4]]
Researching Learning Describing Code J. Learning Researching 1	(ii) What is the purpose of the diode in the circuit?	_
Powerting Learning Company Company	[1]]
Researching Learning Describing Flowerstrag GOD	(iii) Suggest a reason for the use of a secondary circuit.	
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- (b) An outline sketch of a steady hand game is shown in Fig. 7. The circuit to operate the steady hand game contains a PIC. The PIC flowchart includes 3 macros called, DISPLAY, ATTEMPTS and SOUND. Each macro will have a specific function:
 - DISPLAY to activate the 3 LEDs
 - ATTEMPTS to count the number of failed attempts
 - SOUND to activate a buzzer after the third failed attempt

To start the game the **DISPLAY** macro must first be turned on.

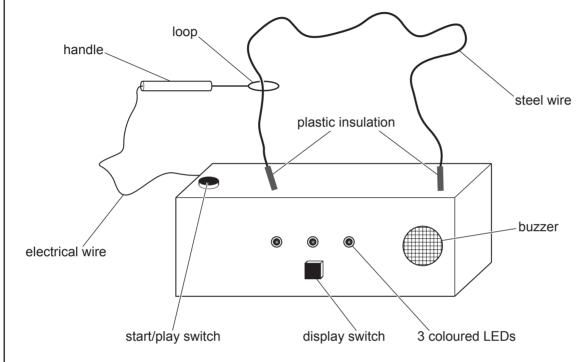


Fig. 7

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Tables 1 and **2** show the inputs and outputs which are used in the PIC circuit.

Table 1

PIC Inputs	Not used	Not used	Start/Play Switch	Display Switch	Loop Contacts Steel Wire
BIT	4	3	2	1	0

Table 2

PIC	Not	Not	Not	Buzzer	Not	Green	Yellow	Red
Outputs	used	used	used		used	LED	LED	LED
BIT	7	6	5	4	3	2	1	0

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(i) Macro 1 DISPLAY

A display showing 3 different coloured LEDs will operate when the display switch is turned on.

Complete the **DISPLAY** macro in **Fig. 8**. When the display switch is turned on a red LED will turn on. Then after 0.5 seconds a yellow LED will turn on and after another 0.5 seconds a green LED will turn on. When all the LEDs are on the macro ends.

Beside each input and output cell, indicate the relevant bit pattern.

DISPLAY		BIT PATTERN
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Fig. 8 [10]

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(ii) Mad	ro 2 AT	TEMPTS
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Complete the ATTEMPTS macro in Fig. 9 as follows:

During the game the player will have 3 chances. Each time the loop touches the steel wire an LED will turn off. The green LED will turn off first, then the yellow LED and finally the red LED will turn off. When all the LEDs are off the macro ends.

Show the relevant bit pattern opposite each input and output cell.

ATTEMPTS		BIT PATTERN
•		
	Fig. 9	[10]

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(iii) Macro 3 SOUND

When all the LEDs are turned off a buzzer will switch on and off five times.

Complete the **SOUND** macro in **Fig. 10** to enable the buzzer to switch on and off five times before ending. The buzzer should remain on for 2 seconds and switch off for 1 second each time.

Bit patterns are not required.

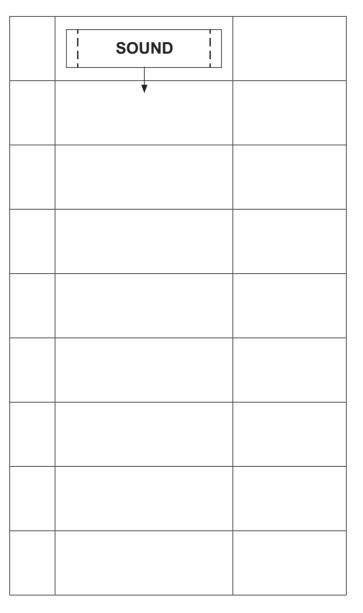


Fig. 10 [7]

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Figure 1

(c) Complete the flow chart in **Fig. 11** to represent the steady hand game program as follows:

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Total Question 2

To start the game the **DISPLAY** macro must operate first. The start/play switch is then turned on.

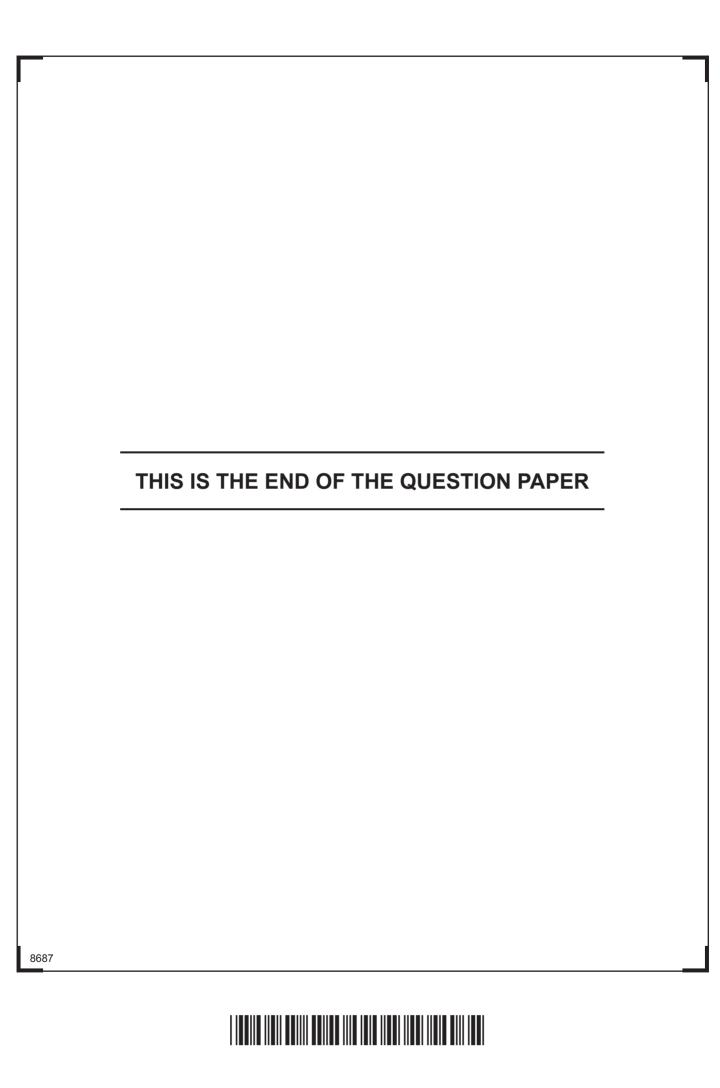
This is then followed by the **ATTEMPTS** macro. After 1 second delay the **SOUND** macro then operates.

The game is now over.

Bit patterns are not required.

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Fig. 11 [7]



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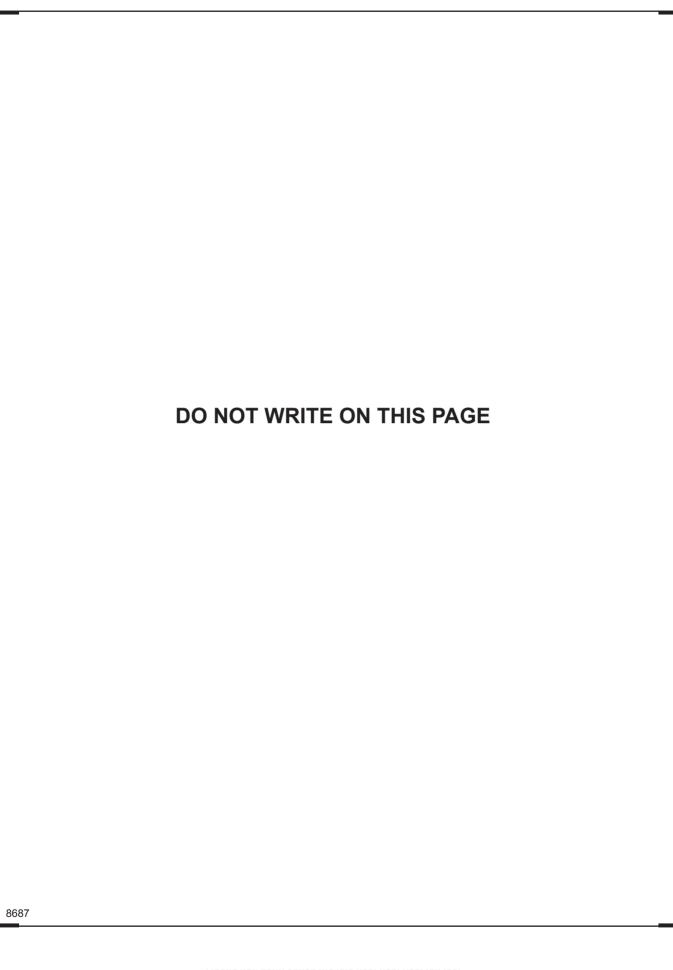
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