Centre Number

71

Candidate Number

Rewarding Learning

**General Certificate of Secondary Education
2012**

Technology and Design

Unit 2: Systems and Control

Element 1: Electronic and Microelectronic Control Systems

GTD21

[GTD21]

TUESDAY 29 MAY, 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.
Answer **all** questions.
On **page 3** we have provided formulae for you to use with this paper.

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.

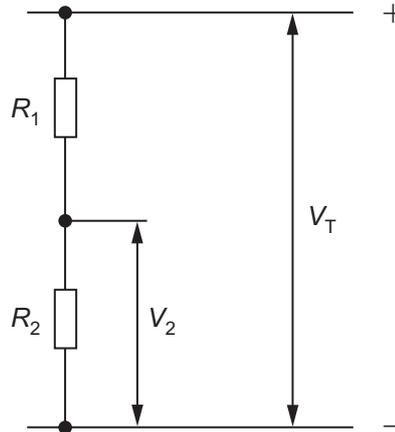| For Examiner's use only	
Question Number	Marks
1	
2	
Total Marks	

7323

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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

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

3   Series Resistors $R_T = R_1 + R_2 + R_3 \ etc$

Parallel Resistors $\dfrac{1}{R_T} = \dfrac{1}{R_1} + \dfrac{1}{R_2}$ or $R_T = \dfrac{R_1 \times R_2}{R_1 + R_2}$

4   Time Constant $T = R \times C$

Answer **all** questions.

1 **(a)** **(i)** State or explain Ohm's Law.

_____

_____

_____ [3]

(ii) Calculate the current flow in the circuit shown in **Fig. 1**.

2.2 Ω

9V

5.6 Ω

Fig. 1

Calculations

[4]

4
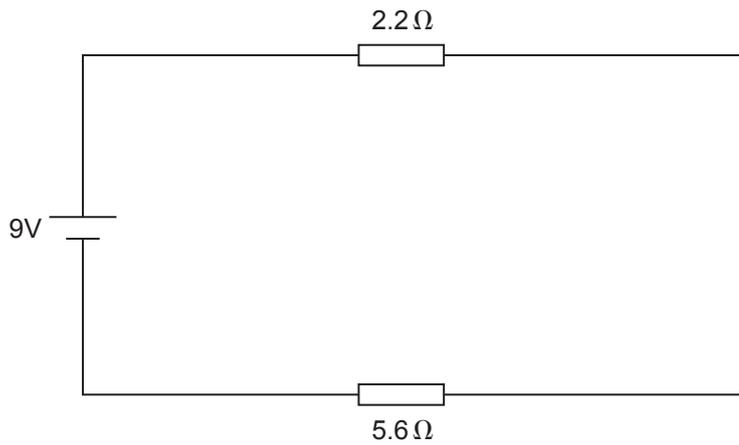
**(iii)** Use **Fig. 1** to show how an ammeter would be connected in this circuit. [2]

(iv) Use **Fig. 1** to show how a voltmeter would be connected in this circuit to check the voltage across the 5.6 Ω resistor. [2]

(v) Use calculations to confirm the expected voltmeter reading for part **(iv)** of this question.

Calculations

[4]

(b) (i) Identify each of the two electronic symbols labelled **A** and **B** below, which are used in a relay.
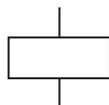
A   B

_____   _____ [2]

(ii) State **two** applications of a relay.

Application 1 _____

_____

Application 2 _____

_____ [4]

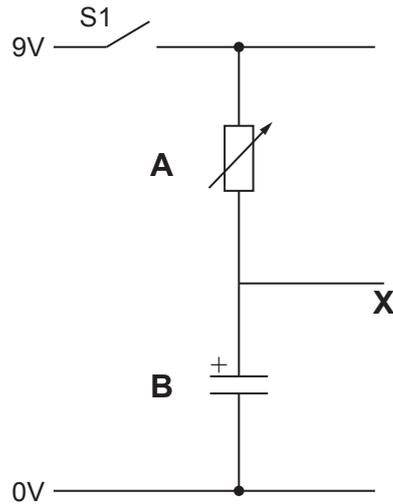**(c)** **Fig. 2** shows an electronic circuit.

Fig. 2

(i) Name the circuit shown in **Fig. 2**.

Name _____ [1]

(ii) Name the components represented by the circuit symbols **A** and **B** in **Fig. 2**.

Component A _____ [1]

Component B _____ [1]

(iii) Describe how this circuit operates to provide an output at point **X**.

_____

_____

_____

_____ [3]

7323   **6**

(d) (i) Complete the circuit in **Fig. 2** by adding a buzzer, resistor and transistor to enable the buzzer to function. [5]

(ii) Outline the primary function of the resistor and transistor in this circuit.

Resistor _____

Transistor _____ [2]

(e) The circuit in **Fig. 2** is to be developed by adding a Push to Make switch across and in parallel with component **B**.

(i) Develop the circuit as described above. [2]

(ii) Describe how this development can influence the operation of the circuit.

_____

_____

_____

_____ [4]

7

[Turn over

2 **Fig. 3** shows an animated display to give directions to subject areas for a school open night. The arms will move up and down as shown by the arrows labelled **A** and **B**. The LEDs will switch on and off and the disc can rotate. The display will be controlled by PIC microcontroller.
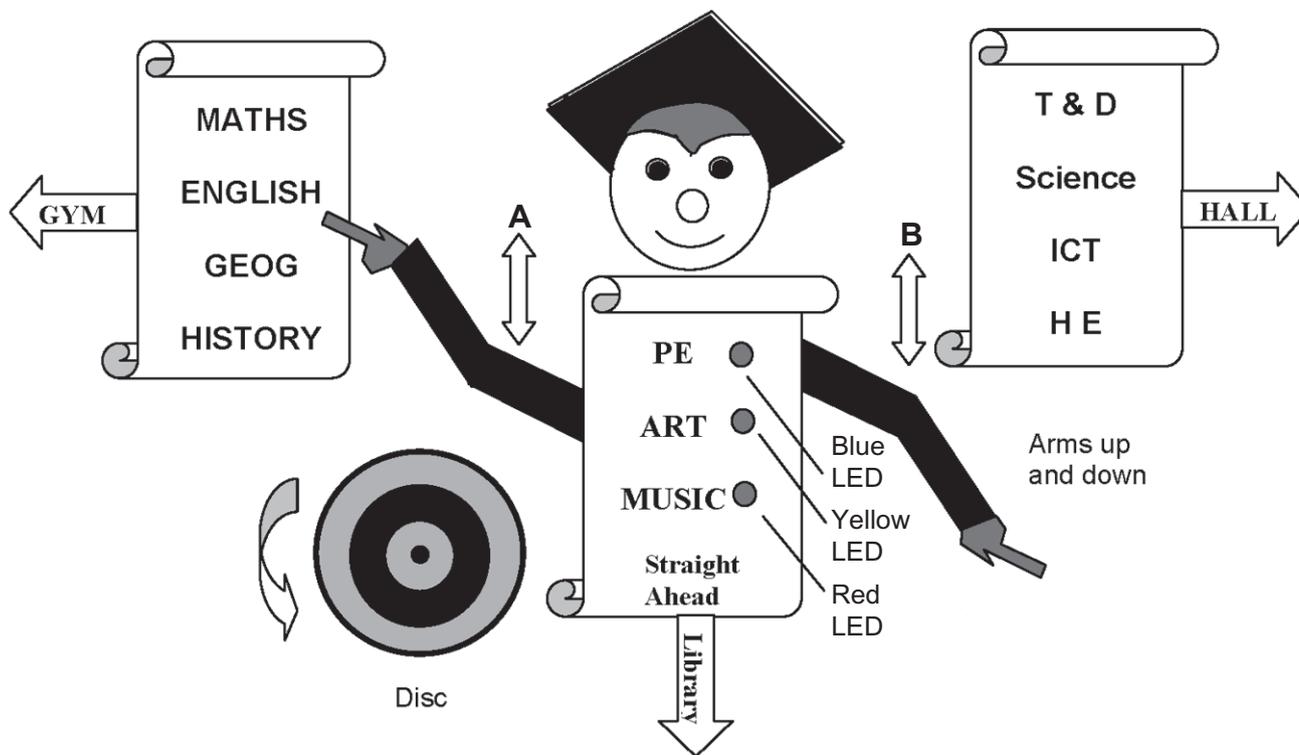

Fig. 3

Six of the eight PIC outputs and two of the PIC inputs are to be used to control the display unit. The output connections are shown in **Table 1** and the inputs are shown in **Table 2**.

Outputs 0, 1 and 2 control the LEDs to illuminate three subjects. Outputs 3 and 4 control the movement of the arms to point to groups of subjects and output 5 controls the revolving disc.

Table 1

PIC Outputs	Not used	Not used	Disc	Arm "**B**"	Arm "**A**"	Blue LED	Yellow LED	Red LED
BIT	7	6	5	4	3	2	1	0

Table 2

PIC Inputs	Not used	Not used	Switch 1	Switch 2	Not used
BIT	4	3	2	1	0

(a) **(i)** Bit patterns make use of binary notation. Write down the bit pattern sequence that can be formed using **3** bits.

_____

_____

_____

_____

_____

_____

_____

_____ [4]

(ii) Convert the decimal number 50 to binary.

_____ [2]

(iii) Convert the binary number 00011100 to decimal.

_____ [2]

(iv) Explain why some outputs from a PIC need to be amplified in order to drive certain output devices.

_____

_____

_____

_____ [2]

(v) Four output devices are listed below. Which of these output devices require amplification when controlled by a PIC?

Output Devices:

LED   **Motor**   **Bulb**   **7 Segment Display**

Answer: _____ [2]

(b) A student constructs a series of flowcharts to represent the overall operation of the animated display unit in **Fig. 3**.

(i) Complete a flowchart and its relevant bit pattern in **Fig. 4** as follows:

- Switch 1 must be pressed to start the routine
- Both arms rise up
- The red and blue LEDs turn on
- All outputs turn off   [10]

	START			BIT PATTERN

Fig. 4

(ii) The student decided to improve the routine for the animated display unit. Complete the flowchart and bit pattern in **Fig. 5** as follows:

- Switch 1 is pressed to start the routine
- Arm A rises and remains in position for 3 seconds and then falls back to its original position
- The Red LED goes on for 7 seconds
- After 2 seconds the Yellow LED goes on for 5 seconds
- All LEDs turn off
- Arm B rises and remains in position for 6 seconds before falling back. During this time the disc rotates
- This routine repeats until switch 2 is pressed. If this switch is pressed the system stops.

10

	START			BIT PATTERN

Fig. 5

[18]

THIS IS THE END OF THE QUESTION PAPER

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