



General Certificate of Secondary Education
2023

Centre Number

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Candidate Number

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Technology and Design

Unit 2

Option A:

Electronic and Microelectronic
Control Systems



[GTY21]

GTY21

TUESDAY 20 JUNE, MORNING

TIME

1 hour 30 minutes.

INSTRUCTIONS TO CANDIDATES

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

You must answer the questions in the spaces provided.

Do not write outside the boxed area on each page or on blank pages.

Questions which require drawing or sketching should be completed using an H.B. pencil.

All other questions must be completed using black ink only.

Do not write in pencil or with a gel pen.

Answer **both** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 100.

Quality of written communication will be assessed in Question **1(e)**.

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

The Formula sheet is on page 3.

13430.06R



16GTY2101

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(Questions start on page 4)

13430.06R



16GTY2102

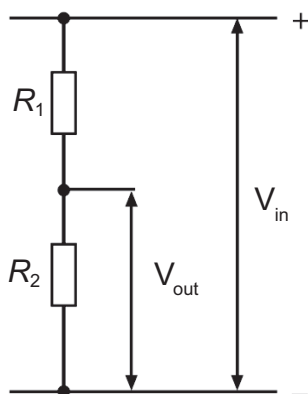


Formulae for GCSE Technology and Design

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 $V_{\text{out}} = \frac{R_2}{(R_1 + R_2)} \times V_{\text{in}}$



3 Series Resistors $R_t = R_1 + R_2 + \dots + R_n$

4 Parallel Resistors $\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2}$ or $R_t = \frac{R_1 \times R_2}{R_1 + R_2}$

5 Time Constant $T = R \times C$

6 Period $T = \frac{1}{f}$

7 Frequency (H_z) $f = \frac{1.44}{(R_1 + 2R_2)C}$ for the output of an astable circuit using a 555 timer

8 Time $T = 1.1 \times C \times R$ for the output of a monostable circuit using a 555 timer

[Turn over

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16GTY2103

Answer **all** questions

1 (a) (i) In the space below, produce a neat sketch of the symbol for a thyristor.

[2]

(ii) Clearly label and name each of the three legs of the thyristor.

[3]

(iii) A thyristor is often used as a latching switch. Explain the operation of a latching switch in a circuit.

_____ [2]

(b) Fig. 1 shows a Potential Divider circuit diagram.

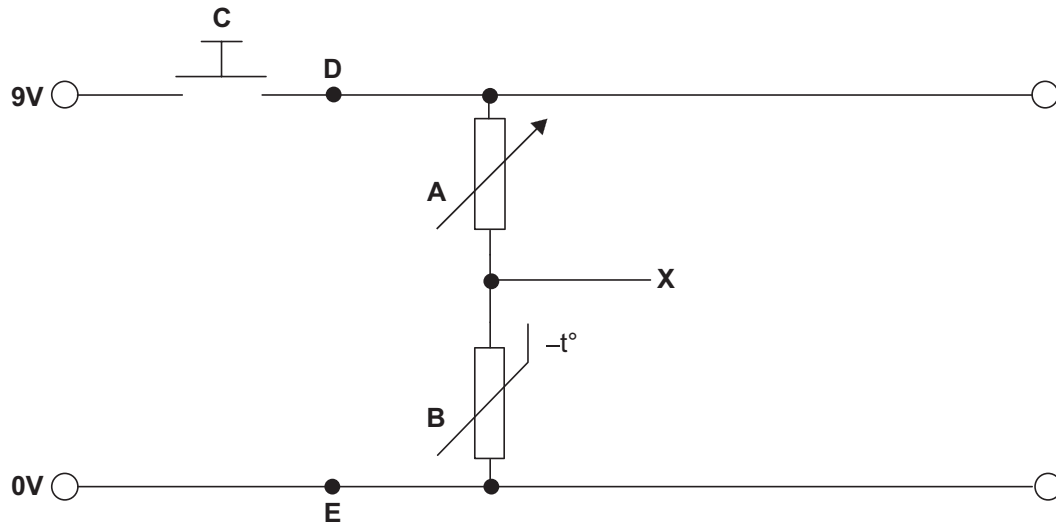


Fig. 1

Source: © Chief Examiner



(i) State another name for this circuit.

_____ [1]

(ii) Name the components shown by their electronic symbols **A** and **B** in **Fig. 1**.

Component A _____ [1]

Component B _____ [1]

(iii) What type of switch is shown at **C** in **Fig. 1**?

_____ [1]

(iv) Explain how the voltage at point **X**, in **Fig. 1**, is obtained and how its value depends on components **A**, **B** and **C**.

_____ [4]

[Turn over

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16GTY2105

(c) The circuit in **Fig. 1** is to be developed by including a resistor and an LED between the 9V and 0V rails at points **D** and **E**.

(i) Sketch this addition to the circuit in **Fig. 1**. [4]

(ii) With reference to the labelled component **C**, explain how the additional parts will function and operate in the circuit.

[4]

(iii) What purpose will this additional part of the circuit serve?

[1]

(iv) If the LED used is rated at 1.9V, 25 mA, calculate in the space below, the minimum value that should be used for the resistor.

Candidates need to show their working out in the space below.

Answer _____

[4]



(d) (i) Develop the circuit in **Fig. 1** to enable an NPN transistor to operate a relay when required. Include any additional components that may be required. Label the NPN transistor and the relay. [7]

(ii) In the space below, state the names of any additional components used and the reason for their use in the circuit.

Additional components and their use

[4]

(iii) Outline **one** possible use for the relay in this circuit.

Use _____

[1]

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[10]

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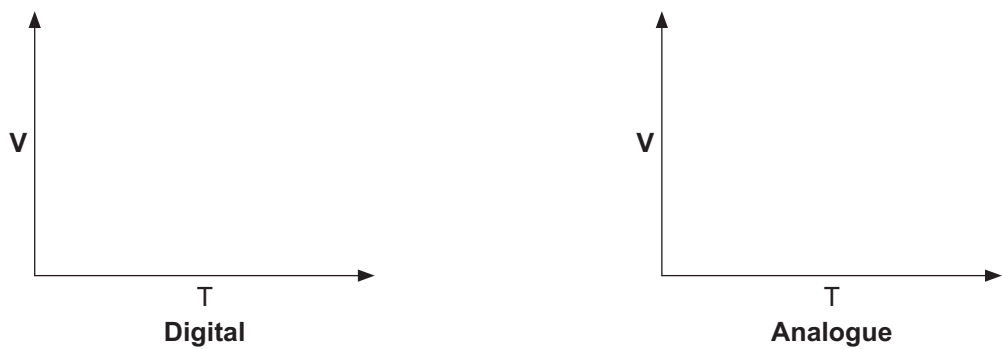


16GTY2109

- 2 (a) (i) Analogue and digital inputs are used in microcontroller circuits. Describe the difference between a digital and an analogue signal.

[2]

- (ii) Sketch on the diagrams in Fig. 2 a typical digital signal and a typical analogue signal.



Source: © Chief Examiner

Fig. 2

[2]

- (b) Complete Table 1 for the four electronic components listed.

Table 1

| Component | Digital or Analogue | Input or Output |
|-----------------|---------------------|-----------------|
| Thermistor | | |
| Solenoid | | |
| Buzzer | | |
| Moisture Sensor | | |

[8]



(c) Compare the use of a microcontroller (PIC) with the use of a 555 timer IC to control circuits by giving **two** advantages of the use of a PIC microcontroller.

Advantage 1: _____

Advantage 2: _____

_____ [2]

[Turn over

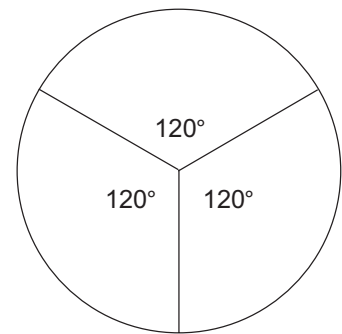
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16GTY2111

(d) A jeweller's shop has installed a display stand to showcase three of its most popular selling watches. The display stand is a revolving turntable and the watches are located around the edge of the stand, 120° apart as shown in **Fig. 3**. One complete revolution of the display stand takes 12 seconds. The display stand operates automatically when the shop is unlocked in the morning and stops operating when the shop is closed and locked up in the evening.

The display stand can rotate clockwise, anticlockwise or remain stationary as required. Four LEDs are located above the front of the stand and are used to illuminate whichever watch is at the front of the stand. A buzzer also operates for 10 seconds when the display is first operated each morning.



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Fig. 3

Tables 2 and 3 show the Input and Output Bits.

A PIC microcontroller is used to control the operations. The PIC has 5 inputs and 8 outputs. An "X" means not used.

Table 2

| Bit | 4 | 3 | 2 | 1 | 0 |
|-------------------|-----------|-------------|---|---|---|
| PIC Inputs | Shop Open | Shop Closed | x | x | x |

Table 3

| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|--------------------|---|---------------------------|-------------------------------|--------|---------|-----------|------------|----------|
| PIC Outputs | x | Turntable Motor Clockwise | Turntable Motor Anticlockwise | Buzzer | Red LED | White LED | Yellow LED | Blue LED |



(iii) Use Fig. 6 to complete the flowchart for the full operation of the display unit.

When the shop is unlocked, the **ROTATE** macro turns on followed by the **DISPLAY** macro. The sequence continues until the shop is locked. It then waits for the shop to open again before continuing.

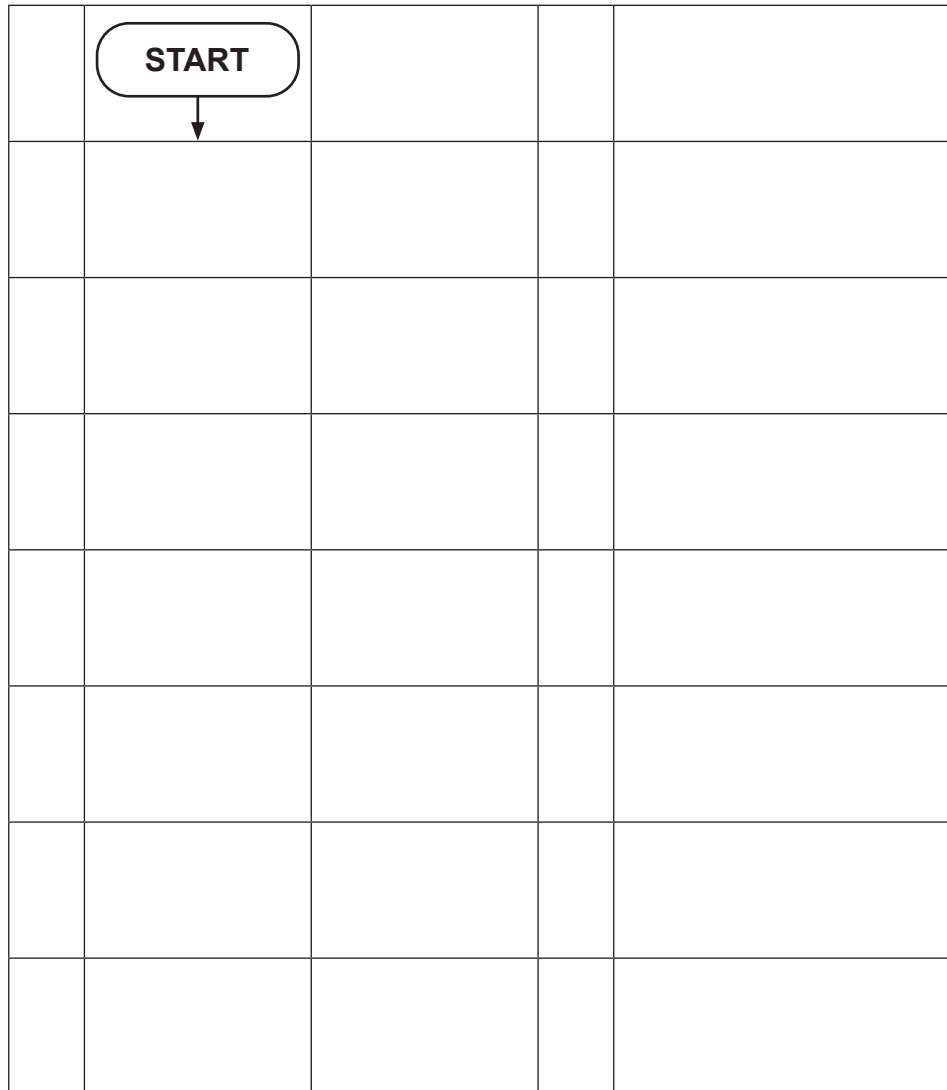


Fig. 6

[12]

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

| | |
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| Total Marks | |
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Examiner Number

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