



**General Certificate of Secondary Education
2023**

Technology and Design

Unit 2

Option A: Electronic and Microelectronic
Control Systems

[GTY21]

TUESDAY 20 JUNE, MORNING

**MARK
SCHEME**

General Marking Instructions

Introduction

Mark schemes are intended to ensure that the GCSE examinations are marked consistently and fairly. The mark schemes provide markers with an indication of the nature and range of candidates' responses. The mark schemes should be read in conjunction with these general marking instructions.

Assessment objectives

Below are the assessment objectives for GCSE Technology and Design.

Candidates must:

- Recall, select and communicate their knowledge and understanding of Technology and Design in a range of contexts;
- Apply skills knowledge and understanding, including quality standards in a variety of design contexts. Plan and carry out investigations and making tasks involving an appropriate range of tools, equipment, materials and processes; and
- Analyse and evaluate evidence, design proposals and outcomes, make reasoned judgements and present conclusions and recommendations.

Quality of candidates' responses

In marking the examination papers, examiners should be looking for a quality of response reflecting the level of maturity which may reasonably be expected of a 16-year-old which is the age at which the majority of candidates sit their GCSE examinations.

Flexibility in marking

Mark schemes are not intended to be totally prescriptive. No mark scheme can cover all the responses which candidates may produce. In the event of an unanticipated answer, examiners are expected to use their professional judgement to assess the validity of answers. If an answer is particularly problematic, then examiners should seek the guidance of the Supervising Examiner.

Positive Marking

Examiners are encouraged to be positive in their marking, giving appropriate credit for what candidates know, understand and can do rather than penalising candidates for errors or omissions. Examiners should make use of the whole of the available mark range for any particular question and be prepared to award full marks for a response which is as good as might reasonably be expected of a 16-year-old GCSE candidate.

Awarding zero marks

Marks should only be awarded for valid responses and no marks should be awarded for an answer which is completely incorrect or inappropriate.

Types of mark schemes

Mark schemes for tasks or questions which require candidates to respond in extended written form are marked on the basis of levels of response which take account of the quality of written communication.

Other questions which require only short answers are marked on a point for point basis with marks awarded for each valid piece of information provided.

Levels of response

Tasks and questions requiring candidates to respond in extended writing are marked in terms of levels of response. In deciding which level of response to award, examiners should look for the 'best fit' bearing in mind that weakness in one area may be compensated for by strength in another. In deciding which mark within a particular level to award to any response, examiners are expected to use their professional judgement. The following guidance is provided to assist examiners.

- **Threshold performance:** Response which just merits inclusion in the level and should be awarded a mark at or near the bottom of the range.
- **Intermediate Performance:** Response which clearly merits inclusion in the level and should be awarded a mark at or near the middle of the range.
- **High Performance:** Response which fully satisfies the level description and should be awarded a mark at or near the top of the range.

Marking calculations

In marking answers involving calculations, examiners should apply the "own figure rule" so that candidates are not penalised more than once for a computational error.

Quality of written communication

Quality of written communication is taken into account in assessing candidates' responses to all tasks and questions that require them to respond in written form. These tasks and questions are marked on the basis of levels of response. The description for each level of response includes reference to the quality of written communication.

For conciseness, quality of written communication is distinguished within levels of response as follows:

Level 1: Quality of written communication is limited.

Level 2: Quality of written communication is satisfactory.

Level 3: Quality of written communication is very good.

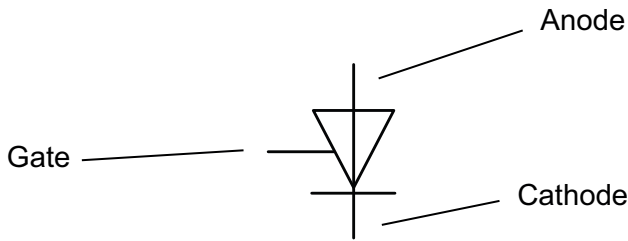
In interpreting these level descriptions, examiners should refer to the more detailed guidance provided below:

Level 1 (Limited): The level of accuracy of presentation, spelling, punctuation and grammar is limited. The candidate makes a limited selection and use of an appropriate form and style of writing. The organisation of material may lack clarity and coherence. There is little use of specialist vocabulary.

Level 2 (Satisfactory): The level of accuracy of presentation, spelling, punctuation and grammar is satisfactory. The candidate makes a satisfactory selection and use of an appropriate form and style of writing supported with appropriate use of diagrams as required. Relevant material is organised with some clarity and coherence. There is some use of specialist vocabulary.

Level 3 (Very Good): The level of accuracy of presentation, spelling, punctuation and grammar is very good. The candidate successfully selects and uses the most appropriate form and style of writing, supported with precise and accurate use of diagrams where appropriate. Organisation of relevant material is very good. There is very good use of appropriate specialist vocabulary.

1 (a) (i)



Neat drawing as per p 66 of specification [2]

(ii) Correct labelling of Gate, Anode and Cathode [3]

(iii) When operated, a latching switch will turn on a circuit output [1]
It will remain on until it is reset [1] [2]

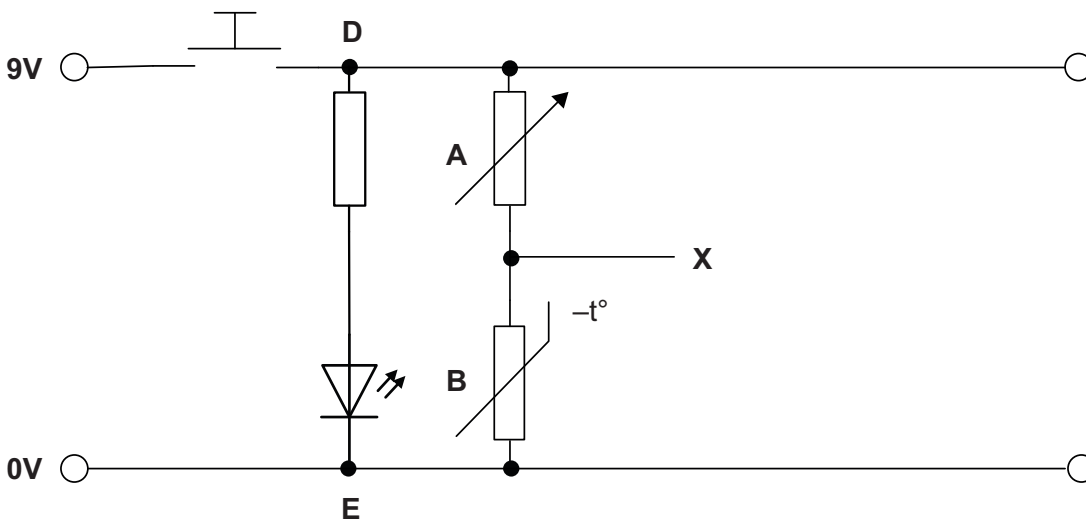
(b) (i) Voltage Divider Circuit or Temperature sensing circuit [1]

(ii) Component A: Variable Resistor [1]
Component B: Thermistor [1]

(iii) Push to Make or PTM [1]

(iv) Reference to:
When the PTM switch is pressed, circuit is switched on/power to circuit [1]
Variable resistor allows the sensitivity of circuit to be set [1]
Assume negative temperature coefficient thermistor
In cold conditions the thermistor resistance increases/vice versa [1]
When this happens current will flow to point x to provide output [1] [4]

(c) (i) Resistor [1]
LED(Arrow directions and orientation) [2]
Connections [1] [4]

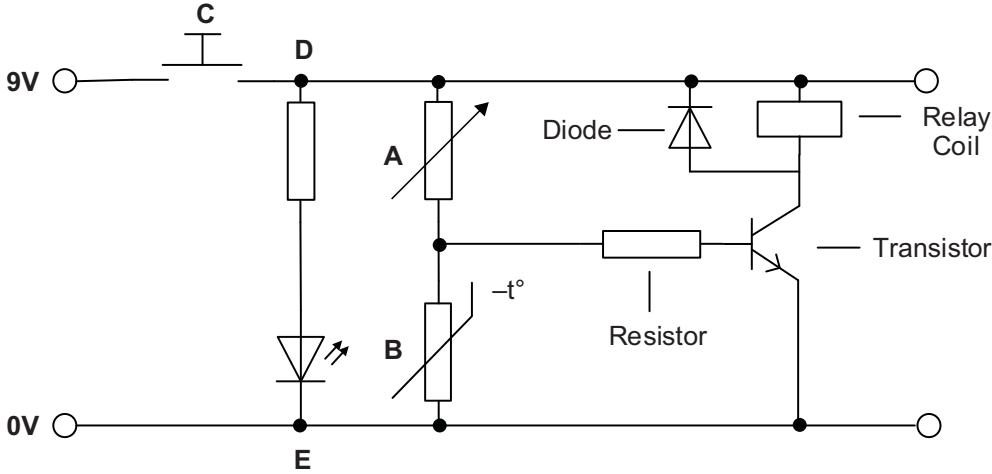


(ii) PTM switch closes, power on [1]
Current flow from 9V line to 0V line [1]
Resistor protects the LED from too high current [1]
LED switched on [1] [4]

(iii) Serves as a circuit on indicator/warning [1]

- (iv) $V = 9 - 1.9 = 7.1V$ [1]
 $R = 7.1/0.025$ [1]
 $R = 0.284k\Omega$ or 284Ω [1] for value, [1] for units [4]

- (d) (i) Relay Coil drawn correctly, labelled and in correct location [1]
 Transistor switch drawn correctly, labelled and in correct position [1]
 Resistor drawn correctly and in correct location [1]
 Diode drawn correctly [1] Orientation [1]
 Diode connections to circuit 9V rail and bottom of relay coil [1]
 Transistor, resistor and relay connections all correct [1] [7]
 (Solution may or may not include a relay switch)



- (ii) Resistor [1]
 To protect the transistor from too high a base current [1]
 Diode [1]
 To protect the circuit from relay coil back EMF [1] [4]
- (iii) To switch on a motor or solenoid or to switch on a higher voltage circuit or to switch on another circuit [1]

(e) Indicative content

A general statement which clarifies the primary reason for their use:

- to aid circuit design and development;
- to provide a visual display of a process;
- to determine the order of events in a process;
- to show a logical order of events in a process;
- to aid understanding in a complex process;
- to help in the design of a process.

Flowchart Elements:

START: This is the first cell in any flowchart

STOP: The flowchart stops when this cell is reached

OUTPUT: This is used to switch outputs on or off

DECISION: This cell is used to decide if a condition is met

WAIT: This causes the program to delay for a given time before continuing

EXPRESSION: This assigns a new value to a variable

INCREMENT: This increases the value of a variable by 1

DECREMENT: This decreases the value of a variable by 1

LOOP: A loop is used to repeat all or part of a flowchart

MACRO: used within the main flow chart, it contains a sequence of instructions

All relevant, valid responses will be given credit

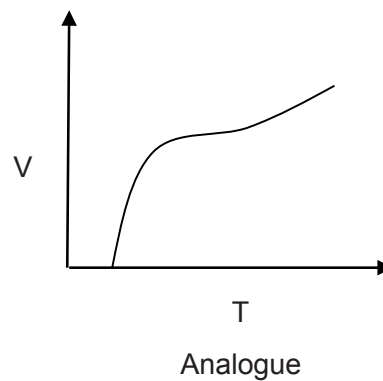
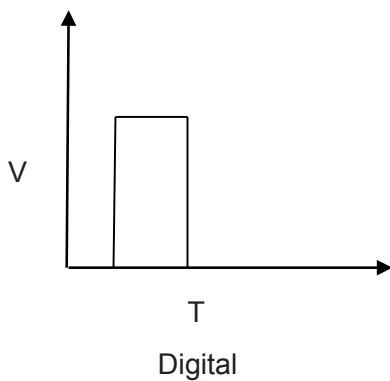
| Response Type | Description | Mark Band |
|---|--|-----------|
| When a response is not worthy of credit, a [0] mark should be awarded | | |
| Limited | Discussion/explanations are limited in content. Four flowchart elements may or may not be considered. The level of accuracy of spelling, punctuation and grammar is limited in most cases. Form and style are generally inappropriate as is the use of technical vocabulary and specialist terms. | [1]–[3] |
| Satisfactory | Discussion/explanations are satisfactory in content. Four flowchart elements may or may not be considered. The level of accuracy of spelling, punctuation and grammar is satisfactory. Form and style are satisfactory in most cases and technical vocabulary and specialist terms are used appropriately in some cases. | [4]–[7] |
| Very Good | Discussion/explanations are clear and comprehensive in content and explanation. Four flowchart elements are considered. The level of accuracy of spelling, punctuation and grammar is very good. Form and style are of a high standard and technical vocabulary and specialist terms are used appropriately. | [8]–[10] |

[10]

50

- 2 (a) (i) Main differences: Digital components are either on or off. [1]
 Analogue components give a constant signal that varies in strength/weakness. [1] [2]

(ii)



[2]

(b)

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

(8 × [1])

[8]

- (c) Compared to a 555Timer IC:
 A PIC allows for simulation and testing
 A PIC has more outputs
 A PIC requires fewer external components
 A PIC allows greater flexibility
 A PIC can be programmed to change its function
 A PIC can reduce the size of a circuit
 A PIC is more easily adjusted for complex sequences
 PIC has a wider range of applications
 (2 × [1])

[2]

All relevant, valid responses will be given credit

(d) (i)

| | | | |
|---------------|--|-----|--|
| ROTATE | | | |
| Motor on c/w | | 1+1 | |
| Wait 24sec | | 1 | |
| Motor off | | 1 | |
| Motor on a/c | | 1 | |
| Wait 24sec | | 1 | |
| Motor off | | 1 | |
| END | | 1+1 | |

[9]

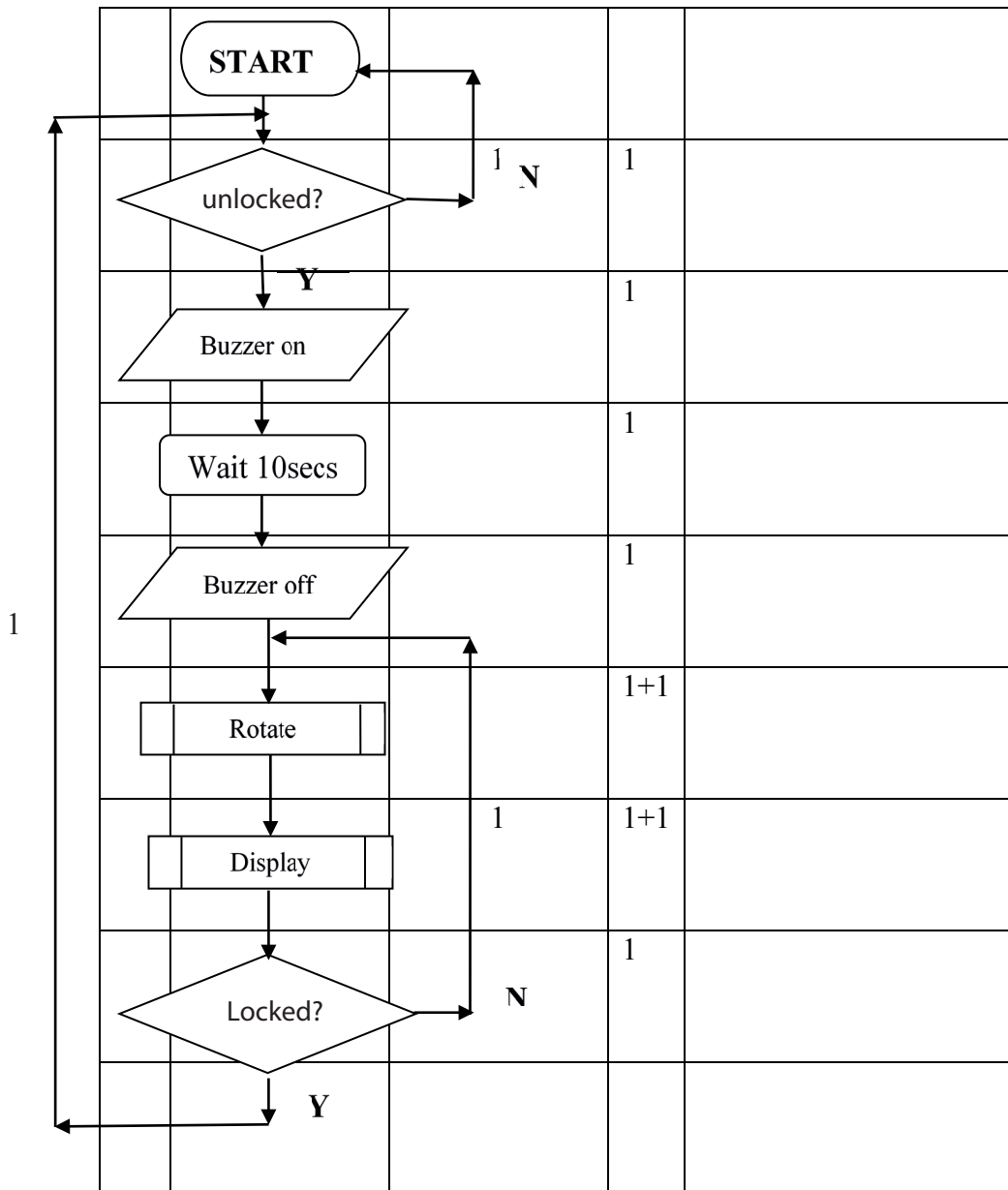
(ii)

| | | | | |
|----------------|--|---|-----|-------------|
| DISPLAY | | | | Bit Pattern |
| A=0 | | | 1 | |
| Motor on C/W | | | 1+1 | |
| Wait 4secs | | | 1 | |
| Motor off | | | 1 | |
| All LEDs on | | | 1+1 | X0001111 |
| Wait 6secs | | 1 | 1 | |
| All LEDs off | | | 1 | |
| A=A+1 | | | 1 | |
| Is A ≥ 9 | | | 1+1 | |
| END | | | 1+1 | |

AVAILABLE MARKS

[15]

(iii)



[12]

Total

AVAILABLE MARKS

50

100