Rewarding Learning

**General Certificate of Secondary Education
2019**

Technology and Design

Unit 2
Option A: Electronic and Microelectronic
Control Systems

[GTY21]

FRIDAY 31 MAY, 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) X = Polarised capacitor [1] Process [1]   [2]
Y = Moisture sensor [1] Input [1]   [2]
Z = 7 segment display [1] Output [1]   [2]

(ii) Robust base for the circuit/Neater circuit produced/Can be fixed
inside a casing/A more compact circuit can be produced/Reduces the
amount of wires needed/Easier to check or test circuit/Platform to fix
components on.
(2 × [1])   [2]

Correct alternative answers will be considered

(b)
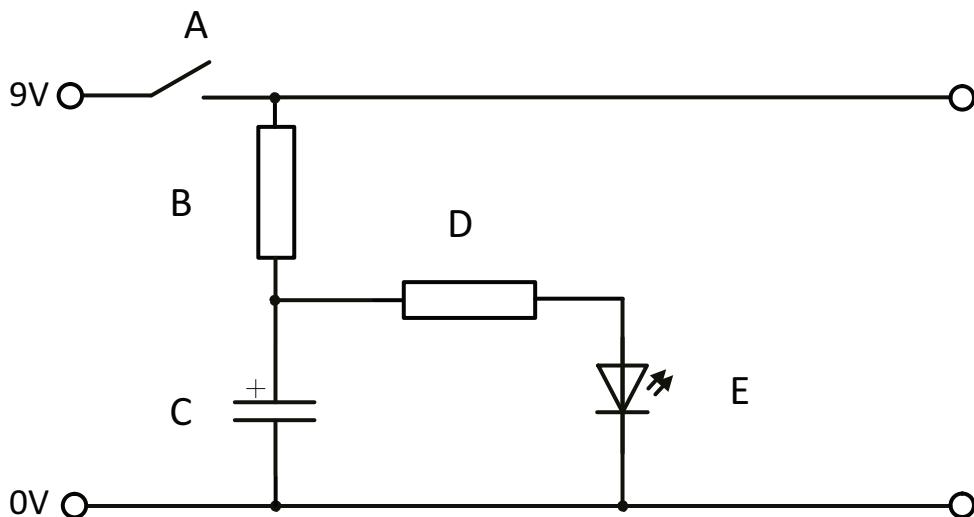
(i) Single pole single throw   [1]

(ii) Light Emitting Diode   [1]

(iii) Capacitor charges up [1]
Time delay created [1] between switch A closed and LED
turning on [1]   [3]

(iv) When the switch A is opened capacitor discharges [1]
When the voltage across C is low, the LED will go out [1]   [2]

(v) Component D serves as a protective resistor [1] for the LED [1]   [2]

(vi) V = I × R
R = V/I
V = 9 – 2 = 7V [1]
R = 7/20 [1]
R= 0.35 [1] kΩ [1] or (R/0.020 = 350Ω)   [4]

(vii) V_{out} = R2/(R1 + R2) × V_{in}
2700/(1800 + 2700) x 9 [2]
2700/4500 × 9 [1]
0.6 × 9 [1]
5.4 [1] V [1]   [5]

(c) (i) Astable = X [1]
Will flash an LED [1] continually [1]
A circuit that generates/produces pulses
Switches back and forth
Not stable in any state
(any one) [2]

Monostable = Y [1]
Generates/produces a set time delay [1] then resets [1]
Has one stable state
Switches on something for a set period of time
Sometimes called a one-shot
(any one) [2]

(ii) Square waveform
5 volts when high
Close to 0 volts when low
High lasts for 3 ms
Low lasts for 3 ms
Period lasts for 6 ms
Continuous switching between high and low
(4 × [1]) [4]

(iii) T = 1/f hence f = 1/T [1]
Use of 6 ms   or   0.006 sec
1/6 [1]   1/0.006 [1]
0.167 [1] kHz [1]   166.7 [1] Hz [1] [4]

(d) Indicative content:
Reference to:
• use to protect other electronic components and devices
• use to control, e.g. volume
• use in Potential Divider circuits
• Function of three colour bands to identify value
• Function of fourth colour band to identify tolerance
• The colour of the fourth band indicates the percentage range
• Reference to tolerance in resistors
• The value of a resistor is not precise
• The value is within a range (+/-) of the stated value
• Need to select nearest preferred value [10]

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. Five points may or may not be considered. The level of accuracy of spelling, punctuation and grammar is limited in most cases. Form and style is generally inappropriate as is the use of technical vocabulary and specialist terms.	**[1]–[3]**
Satisfactory	Discussion/explanations are satisfactory in content. Five points may or may not be considered. The level of accuracy of spelling, punctuation and grammar is satisfactory. Form and style is 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. Five points are considered. The level of accuracy of spelling, punctuation and grammar is very good. Form and style is of a high standard and technical vocabulary and specialist terms are used appropriately.	**[8]–[10]**

AVAILABLE MARKS

50

2 (a) Any **three** from the list below:
  • Robots used in manufacturing create efficiencies all the way from raw material handling to finished product packing
  • Robots can be programmed to operate 24/7 in lights-out situations for continuous production
  • Robotic equipment is highly flexible and can be customized to perform even complex functions
  • Robotics helps manufacturers embrace automation to stay competitive.
  • Robotics can be highly cost-effective, over time, for nearly every size of company
    (3 × [1])   [3]

  Correct alternative responses will be considered

(b) Any **three** from the list below:
  • The robotic mowers cut little and often resulting in smaller clippings which are left to mulch into the ground. Conventional mowers are used less often and the grass box must be emptied many times.
  • The robotic mower will automatically charge and find its own way back to its charging station. Conventional mowers either have to be filled with fuel or manually charged.
  • Robotic mowers take up less storage space compared to a conventional mower
  • As the robotic lawn mower continuously repeats cutting the grass day and night on its own whereas the conventional lawn mower must be pushed around the lawn taking a lot of time.
  • Low noise by the robotic mower means it doesn't disturb neighbours whereas conventional mowers make a lot of noise.
  • Conventional mower must be guided around a garden and be pushed around obstacles, the robotic mower will learn to redirect itself around obstacles without causing damage.
  • The robotic mower is safer because if it is lifted the blades stop immediately whereas the conventional mower will continue to spin.
    (3 × [1])   [3]

  Correct alternative responses will be considered

(c) Any **three** from the list below:
  • size of a circuit can be reduced significantly – one microcontroller can replace several other ICs
  • allows greater flexibility – can be reprogrammed to change its function
  • They can be programmed to respond to one or more inputs and to control one or more outputs.
  • Some microcontrollers also have the capability to accept and process analogue inputs, play ringtones and run parallel programs at the same time.
    (3 × [1])   [3]

  Correct alternative responses will be considered
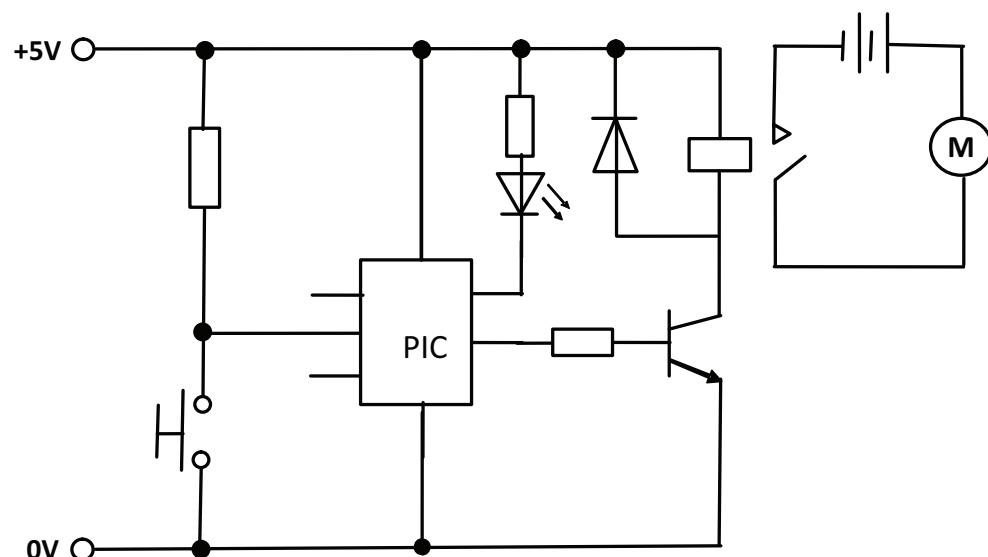
AVAILABLE MARKS

(d)

AVAILABLE
MARKS

(5 × [2])   [10]

11887.01 **F**   **8**

(e) (i)

```
      ┌ - - - - - - - - ┐
      │   START UP      │
      └ - - - - - - - - ┘
              │
              ↓      ┌──────┐
          ◇─────────→│      │
        Is SW 1 on?  NO     │
          ◇─────────────────┘
              │
             YES
              ↓
      ╱  Green LED on  ╱
              │
              ↓
      ┌  WAIT 3 sec  ┐
              │
              ↓
      ╱  Buzzer on  ╱
              │
              ↓
      ┌  WAIT 5 sec  ┐
              │
              ↓
      ╱  Buzzer off  ╱
              │
              ↓
      ┌  WAIT 3 sec  ┐
              │
              ↓
      ╱  Motor on c/w  ╱
              │
              ↓
      ┌  WAIT 10 sec  ┐
              │
              ↓
      ╱  Motor off  ╱
              │
              ↓
      ┌ - - - - - - - - ┐
      │      END        │
      └ - - - - - - - - ┘
```

[12]

Correct alternative responses will be considered

(ii)

RAM

Is sw 2 on? — NO

YES

Blue LED on

RAM out

WAIT 4 secs

RAM in

WAIT 5 secs

Motor on a/c

WAIT 10 secs

Motor Off

Green LED &
Blue LED OFF

END
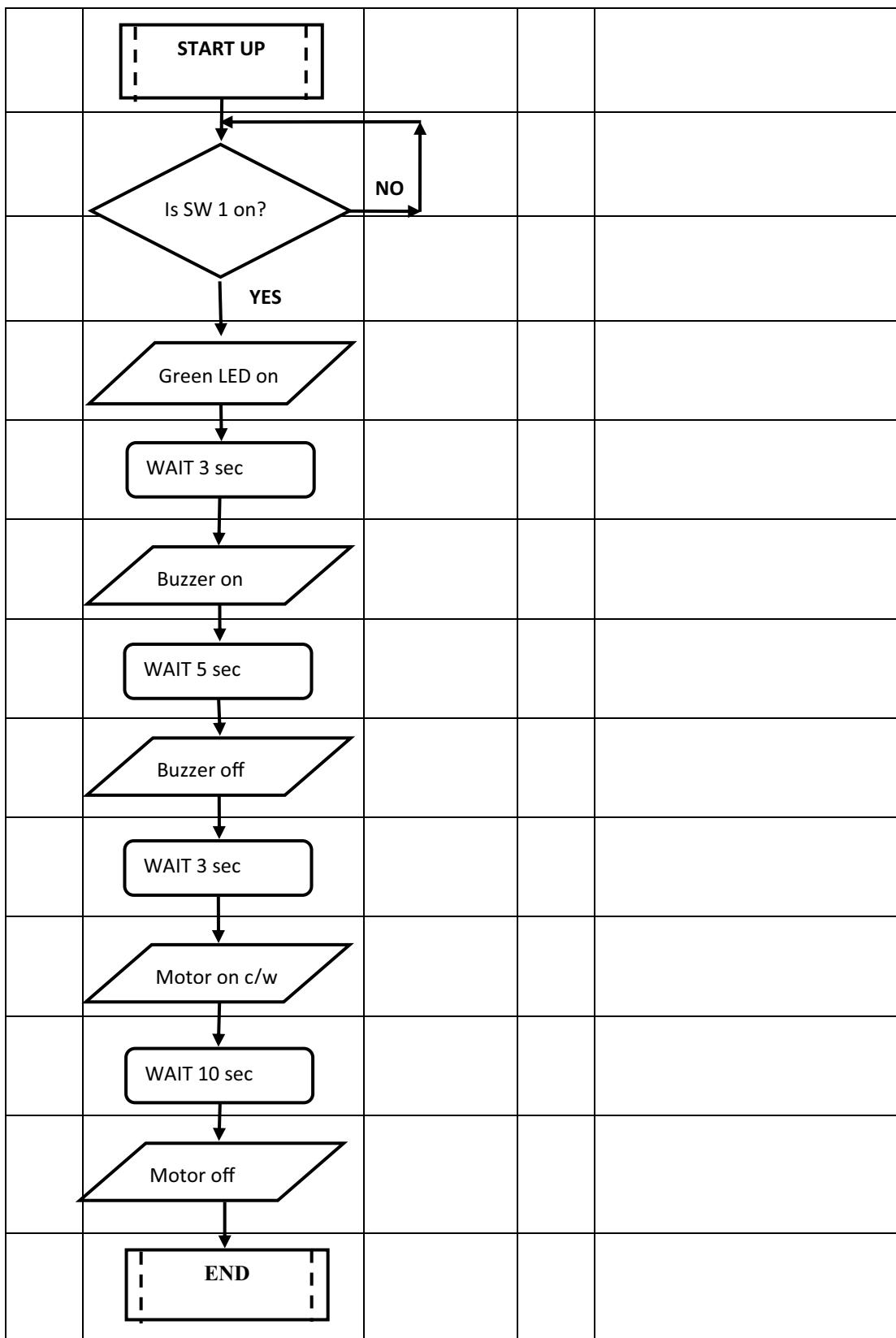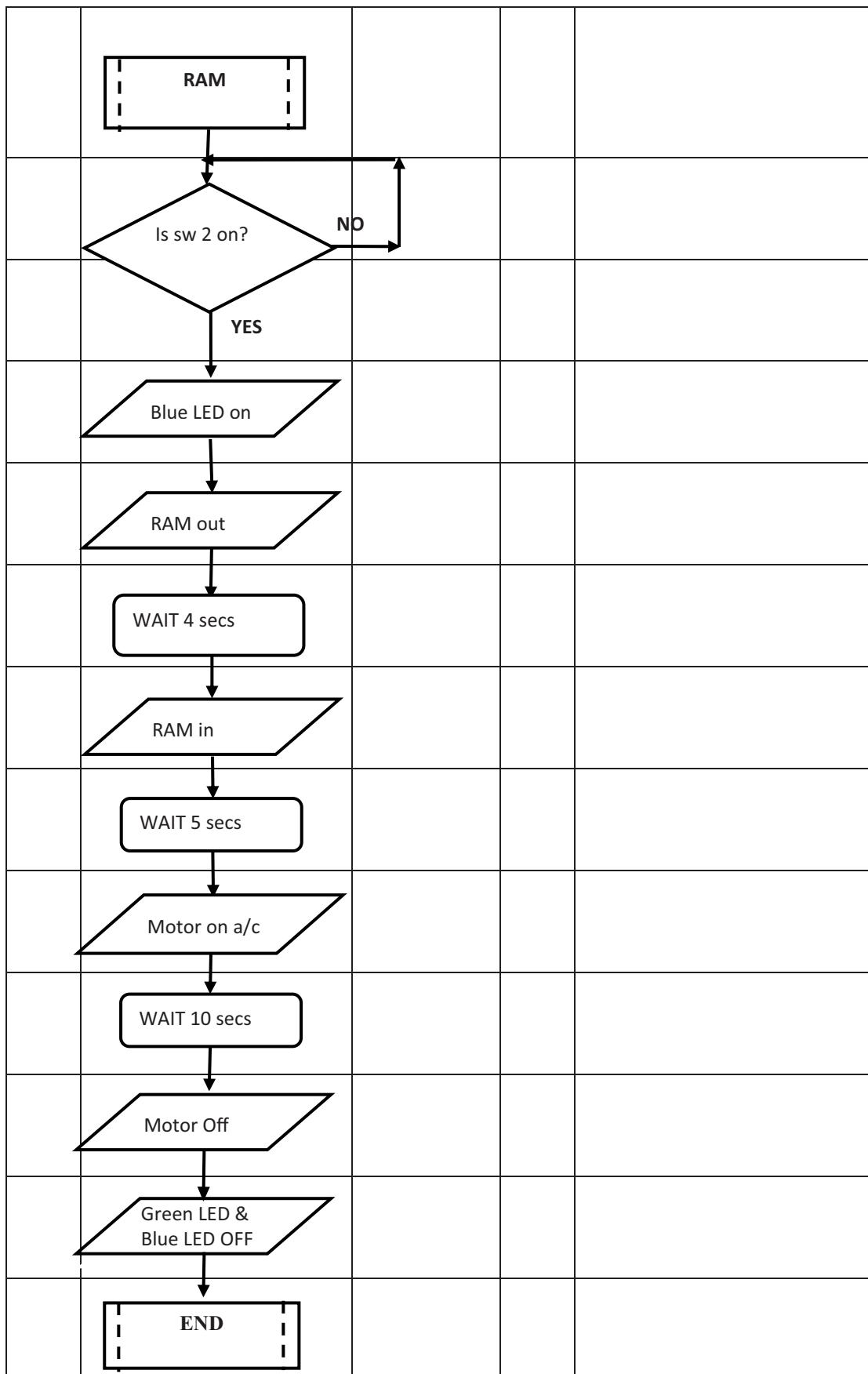
[11]

Correct alternative responses will be considered

(iii)

	AVAILABLE MARKS

```
        ╭─────────╮
        │  START  │
        ╰────┬────╯
             ▼
        ┌─────────┐
        │  A = 0  │
        └────┬────┘
             ▼
       ┌┤ START UP ├┐
       └─────┬──────┘
             ▼
       ┌┤   RAM    ├┐
       └─────┬──────┘
             ▼
       ┌──────────┐
       │ A = A + 1│
       └─────┬────┘
             ▼
           ◇─────◇
          ◇ A ≥ 20? ◇────► NO
           ◇─────◇
             │
            YES
             ▼
        ╭─────────╮
        │  STOP   │
        ╰─────────╯
```

[8]   50

Correct alternative responses will be considered

Total	**100**