



General Certificate of Secondary Education

Technology and Design

Unit 2
Option A: Electronic and Microelectronic
Control Systems

[GTY21]

Assessment

**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.

Students must:

- recall, select and communicate their knowledge and understanding of technology and design in a range of contexts (AO1);
- apply skills, knowledge and understanding, in a variety of contexts and in designing and making products (AO2); and
- analyse and evaluate products, including their design and production (AO3).

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, teachers are expected to use their professional judgement to assess the validity of answers. You must not draw inferences or interpret what you think the candidate has meant. Teachers should carefully read and consider every response

Positive Marking

Teachers 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. Teachers 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. Teachers are encouraged to use the full range of marks available.

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.

Bands of response

Tasks and questions requiring candidates to respond in extended writing are marked in terms of bands of response. In deciding which mark to award, teachers 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 band to award to any response, teachers are expected to use their professional judgement. The following guidance is provided to assist teachers.

Level 1: Response which merits inclusion in the band and should be awarded the lower mark.

Level 2: Response which merits inclusion in the band and should be awarded the higher mark.

Marking calculations

In marking answers involving calculations, teachers should apply the “error carried forward rule” so that candidates are not penalised more than once for a computational error.

Award full marks if a candidate gives the correct answer but does not show the working out.

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 bands of response. The description for each band of response includes reference to the quality of written communication.

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

- Band 1: Quality of written communication is basic.
- Band 2: Quality of written communication is limited
- Band 3: Quality of written communication is satisfactory
- Band 4: Quality of written communication is good.
- Band 5: Quality of written communication is excellent.

In interpreting these band descriptions, teachers should refer to the more detailed guidance provided in question 1(e):

1 (a) (i) Sketch with correct name for Polarised capacitor [1]



Sketch with correct name for Non-polarised capacitor [1]



(2 × [1])

[2]

(ii) Any **one** from the list below:

- farad
- microfarad
- nanofarad
- picofarad

[1]

(iii) To provide a time delay at the output [1]

or

reference to rising/increasing voltage at the output [1]

(1 × [1])

[1]

(iv) A polarised capacitor needs to be connected correctly with reference to the polarity of the circuit [1]

The legs of a non-polarised capacitor can be connected either way [1]

(2 × [1])

[2]

Correct alternative responses should be considered.

(v) Polarised capacitors can have a higher capacitance than a non-polarised capacitor [1]

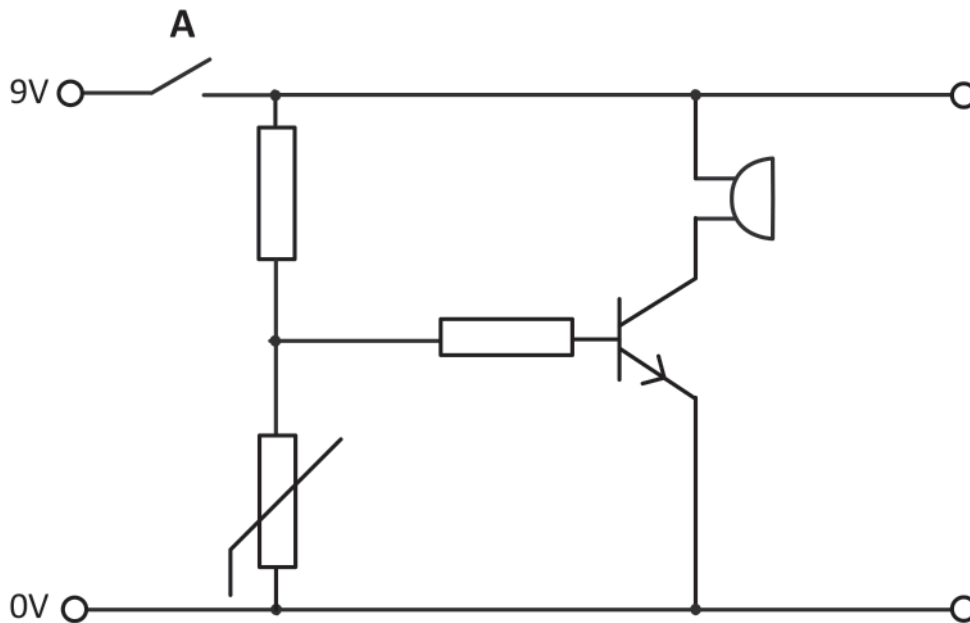
For a given capacitance a polarised capacitor is much smaller in size than a non-polarised capacitor [1]

(2 × [1])

[2]

Correct alternative responses should be considered.

- (b) (i) Thermistor drawn correctly [1] and in correct location. [1]
 NPN transistor correctly drawn [1] and in correct location. [1]
 Protective resistor drawn in correct location. [1]
 Buzzer correctly drawn [1] and in correct location. [1]
 Circuit connections correct. [1]
 (8 × [1]) [8]



- (ii) Operate switch A to turn on the circuit. [1]
 When temperature decreases the resistance of the thermistor increases. [1]
 This enables current to flow to the NPN transistor. [1]
 A resistor is inserted before the transistor to protect against excessive voltage/current. [1]
 The transistor will switch on when the base voltage is 0.6V/0.8V. [1]
 The buzzer will then operate. [1]
 (6 × [1]) [6]

- (c) (i)  [1]

- (ii) An astable [2]
 555 timer [1]
 (2 × [1]) [2]

- (iii) Push to make switch (PTM) [1]
 It enables an astable output [1]
 (2 × [1]) [2]

- (iv) Pin 3 [1]

- (v) Turns off the output [1] when the voltage supply to it reaches 2/3 Vcc [1]
 (2 × [1]) [2]

(d) (i) $f = 1.44 / (R1 + 2R2) \times C$
 $= 1.44 / (1000 + (2 \times 330000)) \times 0.00001$ [1]
 $= 1.44 / 661,000 \times 0.00001$ [1]
 $= 1.44 / 6.61$ [1]
 $f = 0.217\text{Hz}$ [1]

(5 × [1])

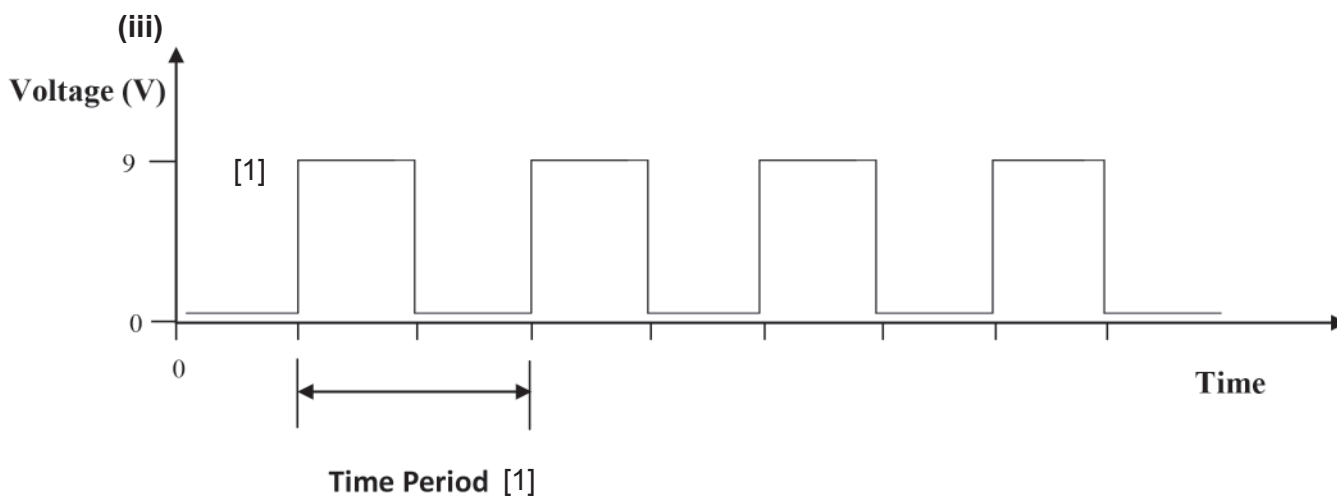
Award full marks if a candidate gives the correct answer but does not show the working out.

[5]

(ii) $T = 1/f$
 $= 1/0.217$ [1]
 $= 4.6$ [1] secs [1]
(3 × [1])

[3]

AVAILABLE MARKS



Axis not required but is shown in the diagram for clarity.

(2 × [1])

[2]

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(e) Bands of response

Tasks and questions requiring candidates to respond in extended writing are marked in terms of bands of response. In deciding which mark to award, teachers 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 band to award to any response, teachers are expected to use their professional judgement. The following guidance is provided to assist teachers.

Level 1: Response which merits inclusion in the band and should be awarded the lower mark.

Level 2: Response which satisfies the band description and should be awarded the higher mark.

Indicative content:

Reference to:

- Tools/Equipment such as soldering iron/station, solder, sponge, pliers, wire cutters, heat sink, de-soldering tool.
- Safety precautions such as soldering iron stand to prevent burns, goggles to protect against solder 'spitting' and good ventilation to remove flux fumes.
- Joining techniques such as checking copper tracks/pads on the PCB are free from grease and fingerprints before inserting electronic component leads/wires into the PCB using pliers if required. (checking for component polarity) Removal of insulation on leads/wires before soldering.
- Heating the joint evenly with the tip of the soldering iron, adding a little solder to the iron to help transfer the heat.
- Applying the solder to the joint ensuring that correct amount of solder used (too much = short circuit. Too little = poor connection.
- Removing solder first then the soldering iron and allowing the joint to cool. Checking the joint for quality and cutting off excess leads. Desolder if necessary using a de-solder sucker. Heat shrinking leads for off board components where required.

AVAILABLE
MARKS

Response Band	Description	Mark
When a response is not worthy of credit, a [0] mark should be awarded		
Basic [1]–[2]	Student responds by completely missing the focus of the question. This response may or may not be well written.	1
	Student response contains little content. It may name some of the safety precautions and tools and/or some steps in the process. The response lacks clarity and coherence and is poorly organised. The level of written communication is basic.	2
Limited [3]–[4]	Student describes very few steps in the production of an electronic circuit and may or may not make reference to some of the tools or equipment. Some safety precautions are given but tend to be general rather than specific to the process. The level of written communication is limited but conveys some information. It is limited in technical vocabulary and specialist terms. Spelling, punctuation and grammar lack accuracy.	3
	Student describes very few steps in the production of an electronic circuit. Some reference to appropriate tools or equipment is given. Some safety precautions specific to the process are given. The level of written communication conveys some information. It lacks technical vocabulary and specialist terms. Spelling, punctuation and grammar lack accuracy.	4
Satisfactory [5]–[6]	Student describes some of the steps in the production of an electronic circuit and makes some reference to choice of tools or equipment. Some safety precautions have been discussed. The level of written communication is satisfactory and contains some technical vocabulary and specialist terms. The accuracy of spelling, punctuation and grammar is satisfactory.	5
	Student describes some of the steps in the production of an electronic circuit and makes some reference to choice of tools or equipment. Some appropriate safety precautions are discussed or described at relevant stages throughout the answer. The level of written communication is satisfactory and contains some technical vocabulary and specialist terms. The accuracy of spelling, punctuation and grammar is satisfactory.	6
Good [7]–[8]	Student correctly describes most or all of the steps in the production of an electronic circuit and makes good reference to choice of tools or equipment. Most safety precautions are referred to throughout the answer. The response is well organised, clear and coherent. The level of written communication and technical vocabulary and specialist terms is generally good. The accuracy of spelling, punctuation and grammar is good.	7
	Student correctly describes most or all of the steps in the production of an electronic circuit and makes very good reference to choice of tools or equipment. Most safety precautions are referred to throughout the answer. The response is well organised, clear and coherent. The level of written communication and technical vocabulary and specialist terms is very good. The accuracy of spelling, punctuation and grammar is very good.	8

Excellent [9]–[10]	Student correctly describes most or all of the steps in the production of an electronic circuit and makes excellent reference to choice of tools or equipment. Most safety precautions are referred to throughout the answer. The level of written communication and technical vocabulary and specialist terms is excellent. The accuracy of spelling, punctuation and grammar is excellent.	9
	Student correctly describes all of the steps required to fully explain the production of an electronic circuit and makes excellent reference to choice of tools or equipment. All relevant safety precautions associated with the tools and processes have been discussed at appropriate points throughout the answer. The level of written communication and technical vocabulary and specialist terms is excellent. The accuracy of spelling, punctuation and grammar is excellent.	10

(10 × [1])

10

50

2 (a) Any **two** of the following in each system:

Microcontroller systems:

- Saves and stores range of instructions [1]
- It can be reprogrammed easily [1]
- It can operate a number of input and output electronic components [1]
- Are used to control mechanical and/or pneumatic systems [1]

Mechanical systems:

- Can create a variety of movements [1]
- x, y and z coordinates [1]
- Makes use of motors to create movement [1]
- A high level of precision movement [1]

Pneumatic systems:

- Pneumatic systems use air and are very reliable [1]
- They require very little maintenance [1]
- Create positive and negative forces [1]
- Pneumatic systems replace human effort in dangerous environments as they are safe [1]
- Pneumatic operations are remotely controlled [1]
(3 × [2])

[6]

Correct alternative responses should be considered

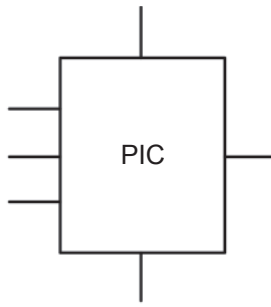
(b)

Types of switch	Application/Use
Reed switch	C
Microswitch	D
Rocker switch	A
Membrane switch	B

(4 × [1])

[4]

(c) (i)



[1]

As per the Appendix 3 of the specification

(ii) Digits 0 and 1

[1]

- (iii) • 0 indicates low or OFF in a system [1]
• 1 indicates high or ON in a system [1]
(2 × [1])

[2]

(iv) 11001

[1]

(v) 74

[1]

(d) (i) Decrement is a subtraction or decreasing of a value usually by 1 [1] in a count [1]
(2 × [1])

[2]

(ii) Expression is an equation/numerical command [1] used to give a value to a variable [1]
(2 × [1])

[2]

AVAILABLE
MARKS

- (e) (i) Award up to three ticks for each flowchart symbol as follows:
- Each flowchart symbol correct as per Appendix 3 of the GCSE Technology and Design specification.
 - Correct instruction within each flowchart symbol.
 - Each flowchart symbol in the correct sequence within the flowchart.

Award up to two ticks for feedback loop as follows:

- Feedback loop linked correctly.
- Yes/No correctly inserted beside decision cell.

Award up to two ticks for presentation of the flowchart as follows:

- Arrowhead on feedback loop as shown in correct direction.
- Connecting arrows on main body of flowchart to show direction of flow.

Total the ticks (40) and divide by 5 to obtain a mark by rounding up or down to the nearest whole number using the common method.

			✓✓✓	
			✓✓✓	
			✓✓✓	
			✓✓✓	
			✓✓✓	
			✓✓✓	
			✓✓✓	
			✓✓✓	
			✓✓✓	
			✓✓✓	
			✓✓✓	
			✓✓✓	
				40/5 = 8 marks

AVAILABLE MARKS

[8]

- (e) (ii) Award up to three ticks for each flowchart symbol as follows:
- Each flowchart symbol correct as per Appendix 3 of the GCSE Technology and Design specification.
 - Correct instruction within each flowchart symbol.
 - Each flowchart symbol in the correct sequence within the flowchart.

Award up to three ticks for feedback loop as follows:

- Feedback loop linked correctly.
- 'Yes' correctly inserted beside decision cell.
- 'No' correctly inserted beside decision cell.

Award up to three ticks for presentation of the flowchart as follows:

- Using minimum number of steps required to complete the flowchart (9 or less not including END macro).
- Arrowhead on feedback loop as shown in correct direction.
- Connecting arrows on main body of flowchart to show direction of flow.

Total the ticks (36) and divide by 6 to obtain a mark by rounding up or down to the nearest whole number using the common method.

			✓✓✓	
			✓✓✓	
			✓✓✓	
			✓✓✓	
✓ Minimum number of steps			✓✓✓	
			✓✓✓	
			✓✓✓	
			✓✓✓	
			✓✓✓	
			✓✓✓	
				36/6 = 6 marks

AVAILABLE MARKS

- (e) (iii) Award up to three ticks for each flowchart symbol as follows:
- Each flowchart symbol correct as per Appendix 3 of the GCSE Technology and Design specification.
 - Correct instruction within each flowchart symbol.
 - Each flowchart symbol in the correct sequence within the flowchart.

Award up to three ticks for feedback loop as follows:

- Feedback loop linked correctly.
- 'Yes' correctly inserted beside decision cell.
- 'No' correctly inserted beside decision cell.

Award up to three ticks for presentation of the flowchart as follows:

- Using minimum number of steps required to complete the flowchart (9 or less not including END macro).
- Arrowhead on feedback loop as shown in correct direction.
- Connecting arrows on main body of flowchart to show direction of flow.

Total the ticks (36) and divide by 6 to obtain a mark by rounding up or down to the nearest whole number using the common method.

✓
Minimum number of steps

			✓✓✓	
			✓✓✓	
			✓✓✓	
			✓✓✓	
			✓✓✓	
			✓✓✓	
			✓✓✓	
			✓✓✓	
			✓✓✓	
			✓✓✓	
				36/6 = 6 marks

[6]

- (e) (iv) Award up to three ticks for each flowchart symbol as follows:
- Each flowchart symbol correct as per Appendix 3 of the GCSE Technology and Design specification.
 - Correct instruction within each flowchart symbol.
 - Each flowchart symbol in the correct sequence within the flowchart.

Award up to three ticks for feedback loop as follows:

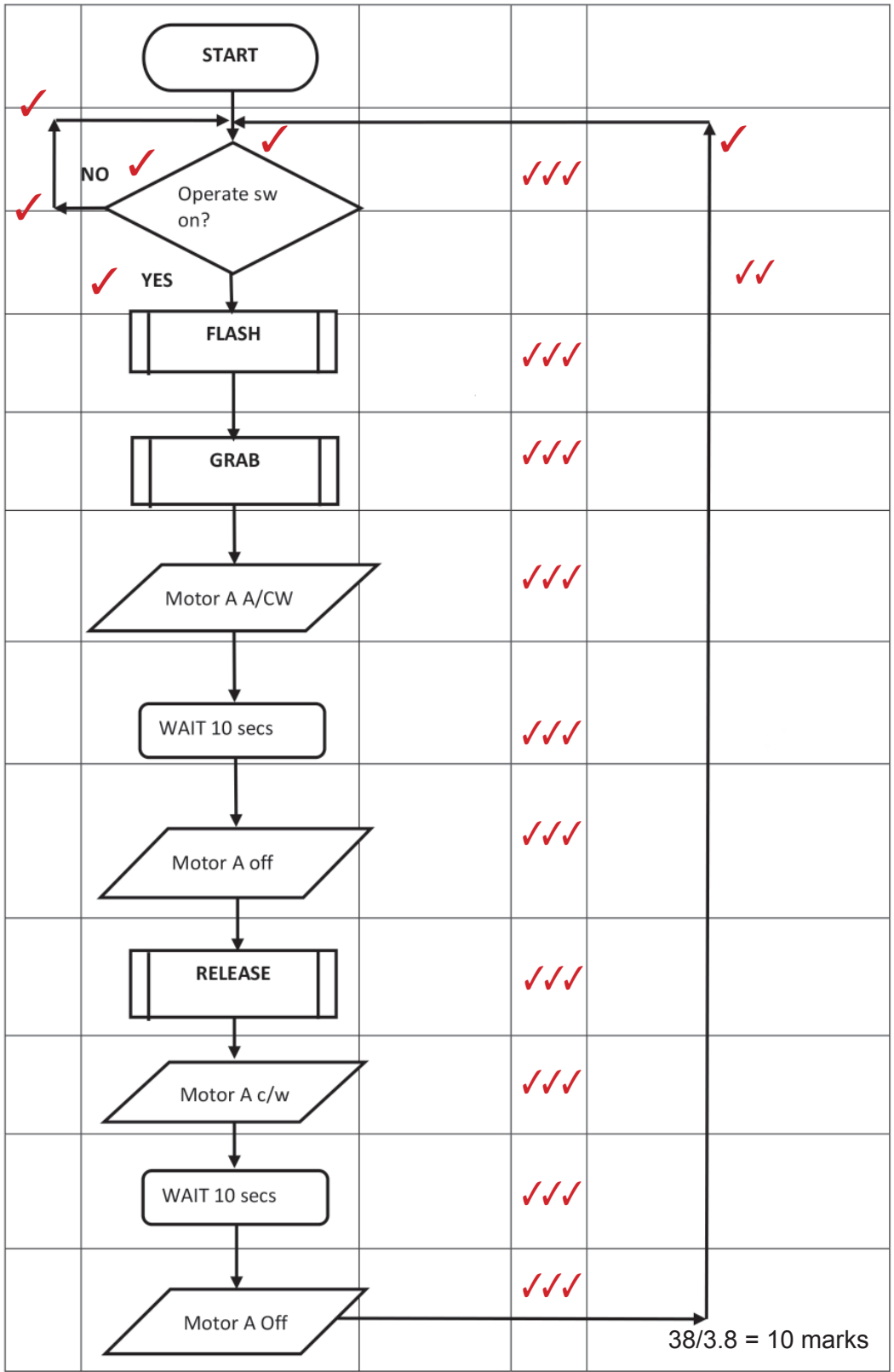
- Feedback loop linked correctly.
- 'Yes' correctly inserted beside decision cell.
- 'No' correctly inserted beside decision cell.

Award up to five ticks for presentation of the flowchart as follows:

- Correct arrow direction on feedback loop.
- Return loop correctly connected.
- Return loop drawn with correct horizontal and vertical lines.
- Arrowhead on return loop shown in correct direction.
- Connecting arrows on main body of flowchart to show direction of flow.

Total the ticks (38) and divide by 3.8 to obtain a mark by rounding up or down to the nearest whole number using the common method

AVAILABLE
MARKS



AVAILABLE MARKS

50
100

[10]

Total