



**General Certificate of Secondary Education
2025**

Technology and Design

Unit 2

Option A: Electronic and Microelectronic
Control Systems

[GT21]

WEDNESDAY 11 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:

- AO1** Recall, select and communicate their knowledge and understanding of Technology and Design in a range of contexts;
- AO2** 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
- AO3** 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.

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, 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:

- 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 level descriptions, examiners should refer to the more detailed guidance provided in the relevant question in the mark scheme.

- 1 (a) (i) A Thyristor [1] Process [1]
 B Seven segment display [1] Output [1]
 C Moisture sensor [1] Input [1]
 D Thermistor [1] Input [1] [8]
- (ii) Feedback is the process of returning part of the output signal from a circuit [1] back to the input of that circuit or device. [1]
- All relevant, valid responses will be given credit** [2]
- (b) (i) $V_{out} = (2600/(1800 + 2600)) \times 9$ [1]
 $= (2600/4400) \times 9$ [1]
 $= 0.59 \times 9$ [1]
 $= 5.32$ [1] V [4]
- (ii) Variable resistor [1]
- (iii) Protective resistor [1]
 to limit the current flowing through the LED. [1] [2]
- (iv) Component K can be adjusted by turning a knob or using a small screwdriver. [1]
 Adjusting component K will allow the sensitivity of the circuit to be adjusted or controls the threshold at which the LED will light up. [2]
- All relevant, valid responses will be given credit** [3]
- (v) Component H is a light dependent resistor. [1]
 In dark conditions the resistance is high. [1]
 This causes the output of the potential divider to be low or the transistor or the LED to be off. [1]
- All relevant, valid responses will be given credit** [3]
- (c) (i) Total resistance = $3 + 4 + 8 = 15$ [1]
 $I = V/R = 9/15$ [1]
 $I = 0.6$ [1] A [1] [4]
- (ii) $1/R$ for parallel resistors = $1/1600 + 1/400$ [1]
 $1/R = 0.003125 \therefore R = 320$ Ohms [1]
 Total R = $320 + 330 + 560 = 1210$ Ohms [1]
 $V = 0.008 \times 1210$ [1]
 $V = 9.68$ [1] [5]
- (iii) Preferred values are a range of standard values. [1]
 When designing a circuit, calculated resistor values must be rounded to a preferred value. [1]
- All relevant, valid responses will be given credit** [2]
- (iv) Coloured bands on the resistor indicate the value. [1]
 Tolerance is the percentage deviation either side of the indicated value. [1]
- All relevant, valid responses will be given credit** [2]

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- (v) Highest = 1800×1.1 [1] = 1980 Ohms [1]
Lowest = 1800×0.9 [1] = 1620 Ohms [1]

[4]

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- (d) Indicative content: – Candidate responses may include reference to the following.

Two examples of use in society:

Industrial robots are programmed to do certain tasks, such as welding, painting, assembly, packaging, labelling, product inspection and testing.

Home-based robots can mow lawns or vacuum floors.

Robots are used to stack warehouse shelves, retrieve goods, and even conduct short-range deliveries.

Space Exploration: Mars explorers such as Sojourner and Perseverance are robots.

Military: Robots that detect/dispose of explosives, search for mines and IEDs.

Entertainment: Toy robots, robot statues, and robot waiters.

Self-driving vehicles.

Reasons for the use of robotics:

They work in hazardous environments such as firefighting or working on a nuclear reactor core reducing the risk to human health.

They're cost-effective and can work continuously without pause.

They increase productivity and can accomplish tedious, repetitive work, freeing employees to tackle more challenging tasks.

They offer better quality assurance. Robots perform repetitive tasks flawlessly without having their performance or productivity vary.

Identify and explain the basic control systems used to produce robotic movement.

Robot systems use motors that move arms into their designated positions.

Sensors are utilised for feedback from the robot's environments. They collect information such as proximity and force resistance and send it to the robot controller.

Sensors enable robots to interact with and manipulate objects in their environment using grippers, suction cups, magnets and welding torches.

Microcontrollers enable robots to process information from sensors, make decisions, and control actuators.

Microcontrollers allow robots to perform complex tasks and interact with their environment.

Response Band	Description	Mark
When a response is not worthy of credit, a [0] mark should be awarded		
Basic [1]–[2]	Candidate responds by missing the focus of the question. This response may or may not be well written.	1
	Candidate response contains little content. It may refer to examples and reasons for the use of robotics in society and may refer to the basic control systems used to produce robotic movement. The response lacks clarity and coherence and is poorly organised. The level of written communication is basic.	2
Limited [3]–[4]	Candidate response contains very limited explanation of examples and reasons for the use of robotics in society and may make very limited reference to the basic control systems used to produce robotic movement. The level of written communication is very limited but conveys some information. It is very limited in technical vocabulary and specialist terms. Spelling, punctuation and grammar lack accuracy.	3
	Candidate response contains a limited explanation of examples and reasons for the use of robotics in society and may make limited reference to the basic control systems used to produce robotic movement. 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.	4
Satisfactory [5]–[6]	Candidate response contains a satisfactory explanation of examples and reasons for the use of robotics in society and may present a satisfactory explanation of basic control systems used to produce robotic movement. The level of written communication is satisfactory and conveys some technical vocabulary and specialist terms. The accuracy of spelling, punctuation and grammar is satisfactory.	5
	Candidate response contains a very satisfactory explanation of examples and reasons for the use of robotics in society and presents a very satisfactory explanation of basic control systems used to produce robotic movement. The level of written communication is very satisfactory and conveys some technical vocabulary and specialist terms. The accuracy of spelling, punctuation and grammar is very satisfactory.	6
Good [7]–[8]	The candidate's explanation of examples and reasons for the use of robotics in society and the explanation of basic control systems used to produce robotic movement is generally good. The level of written communication and technical vocabulary and specialist terms is generally good. The accuracy of spelling, punctuation and grammar is good.	7
	The candidate's explanation of examples and reasons for the use of robotics in society and the explanation of basic control systems used to produce robotic movement is generally very good. 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

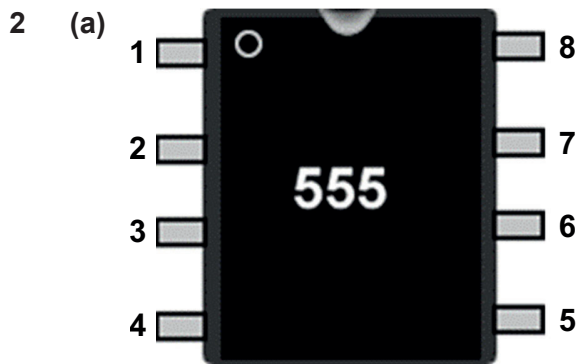
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Excellent [9]–[10]	The candidate's explanation of examples and reasons for the use of robotics in society and the explanation of basic control systems used to produce robotic movement is mostly excellent. The level of written communication and technical vocabulary and specialist terms is mostly excellent. The accuracy of spelling, punctuation and grammar is mostly excellent.	9
	The candidate's explanation of examples and reasons for the use of robotics in society and the explanation of basic control systems used to produce robotic movement is excellent. The level of written communication and technical vocabulary and specialist terms is excellent. The accuracy of spelling, punctuation and grammar is excellent.	10

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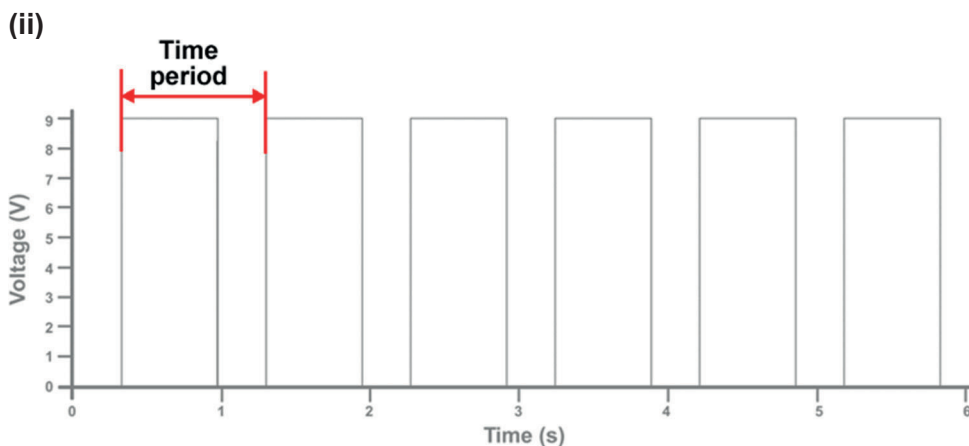


(i) Pin 1 correctly identified [1]
Remaining pins numbered correctly [1] [2]

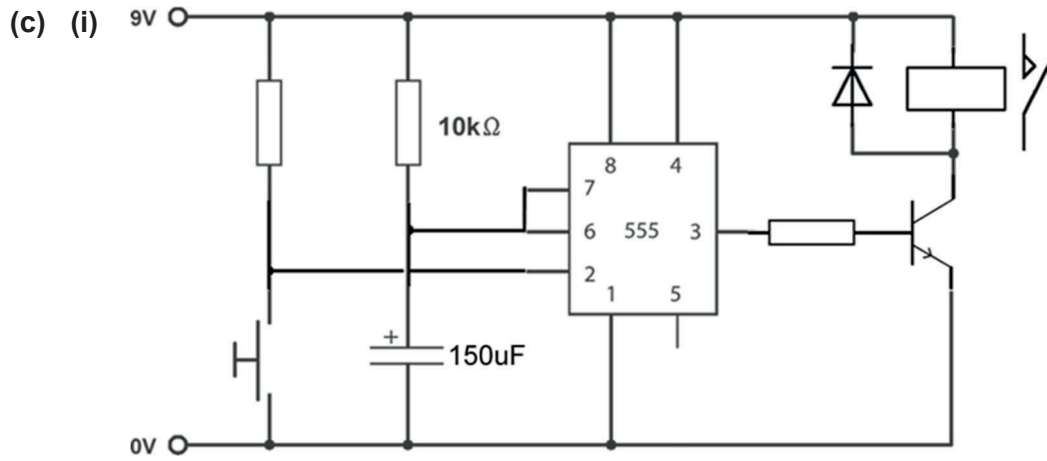
(ii) Dual in line [1]

(b) (i) Astable circuit [1]
In astable mode, the output cycles on and off [1] continuously [1]

All relevant, valid responses will be given credit [3]



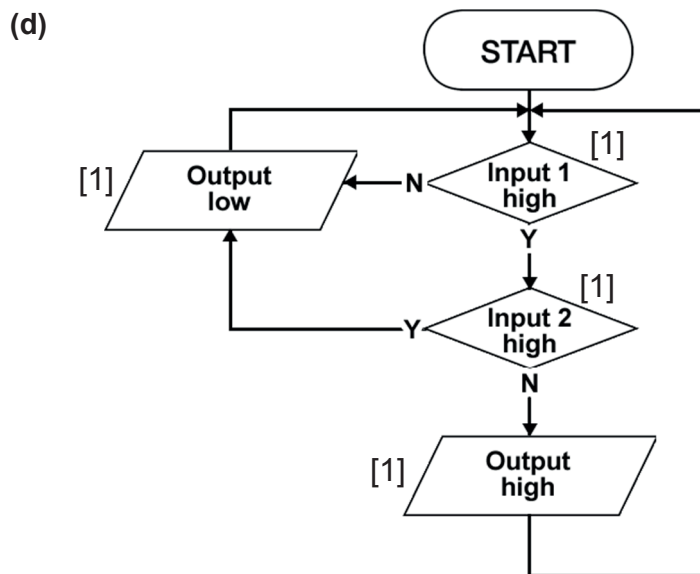
[1]



- Pin 2 connected to switch [1]
 - Pin 6 and 7 connected correctly [1]
 - Pin 3 (output) with protective resistor [1] and transistor [1]
 - Diode symbol for back EMF located correctly [1] and oriented correctly [1]
 - Relay correctly located [1]
 - Relay contact spring return switch correctly located [1]
- [8]

(ii) $T = 1.1 \times R \times C$
 $T = 1.1 \times 10,000 \times 0.00015 [1] = 1.65 [1]$ seconds [1]

[3]



Correct connections [1]
All relevant, valid responses will be given credit

[5]

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(e) (i)

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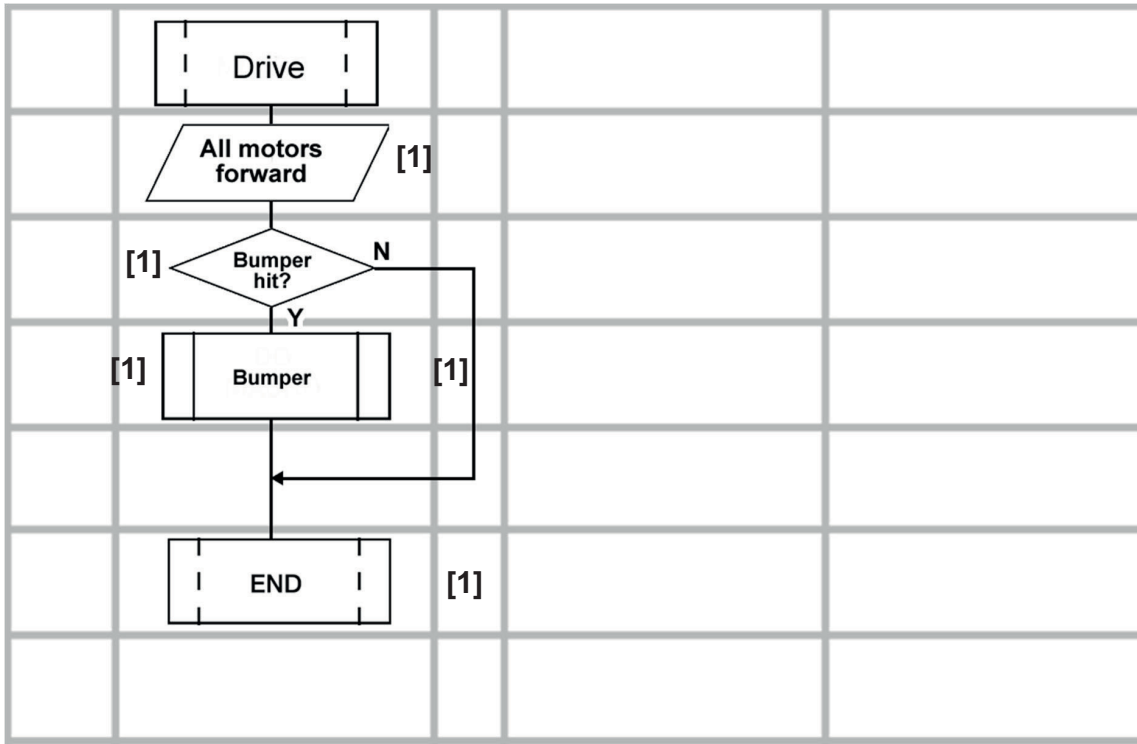
	START			
	BUMPER			
	Buzzer on	[1]		
	All motors stop	[1]		
	Drive motors reverse	[1]		
	Wait 5s	[1]		
	Drive motors stop	[1]		
	Motor A Reverse	[1]		
	Motor B Forward	[1]		
	Wait 5s	[1]		
	Drive motors stop	[1]		
	Buzzer off	[1]		
	END	[1]		

All relevant, valid responses will be given credit

[10]

(ii)

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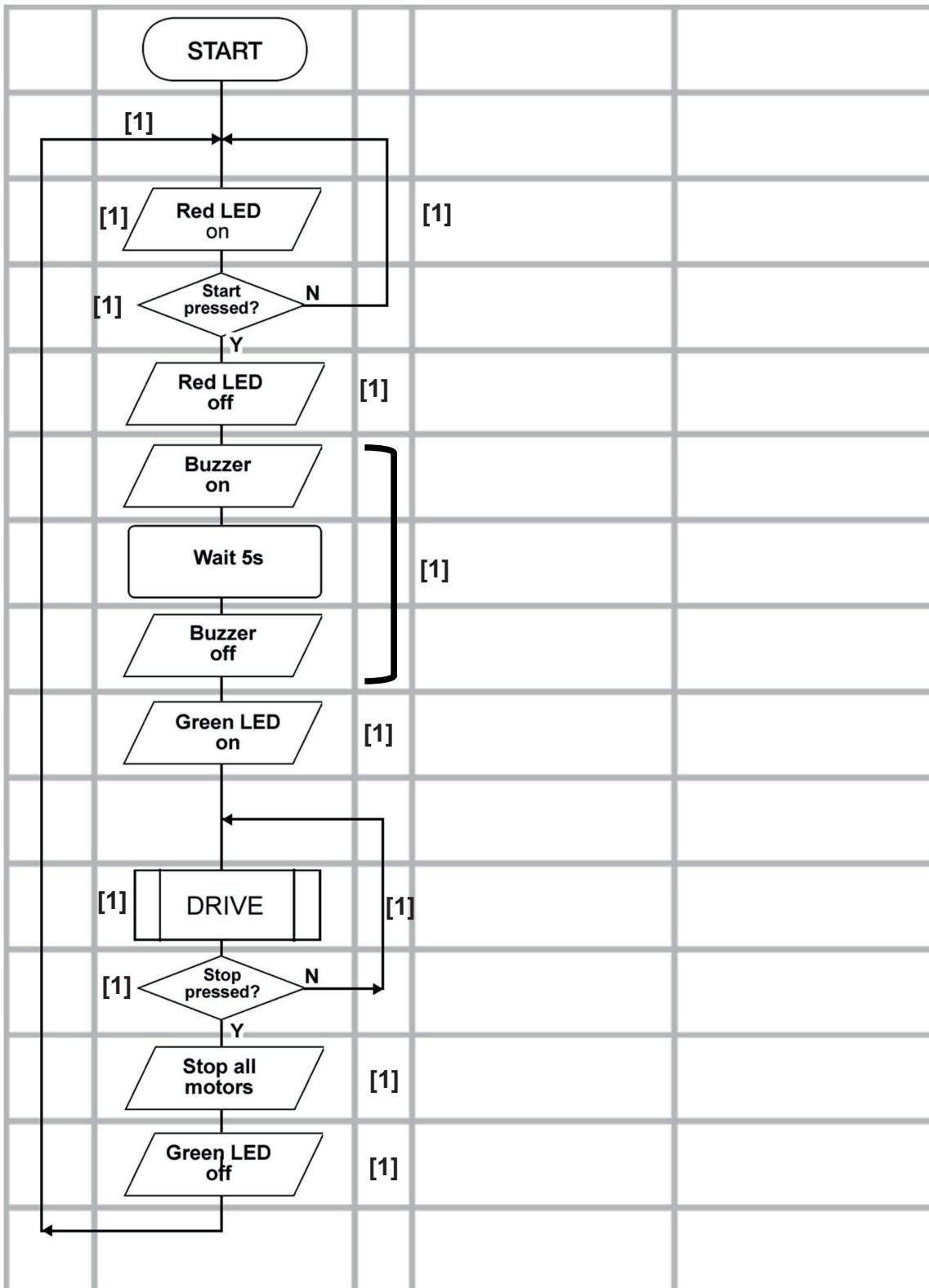


All relevant, valid responses will be given credit

[5]

(iii)

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All relevant, valid responses will be given credit

[12]

50

Total

100