

GCSE
Design & Technology
Systems and Control
Technology

45651 Unit 1 Written Paper
Mark scheme

4565
June 2016

Version: 1.0 Final

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this Mark Scheme are available from aqa.org.uk

COMPONENT NUMBER: 45651

**COMPONENT NAME:
GCSE Design and Technology (System and Control Technology)**

FOR EXAMINERS – PLEASE NOTE THAT IF YOU ARE UNSURE HOW TO AWARD A RESPONSE FROM A CANDIDATE, PLEASE SEEK CLARIFICATION OR ADVICE FROM YOUR TEAM LEADER OR THE PRINCIPAL EXAMINER.

Section A

Qu.	Part	Sub Part	Marking Guidance	Marks
1	(a)		<p>Give two reasons why the bollard system shown above is a suitable method of controlling traffic in a public area.</p> <p>Guidance for Markers The candidate is expected to give two responses, these will generally be associated with:</p> <ul style="list-style-type: none"> • restriction of access for certain vehicles • access to specific vehicle. • pedestrian access • safety • simplicity of system <p>Examples Weak Response (1) mark Eg. It is a safe system.</p> <p>Good Response (2) marks, includes clarification Eg. It is safe because there are no parts to injure pedestrians who walk near it.</p>	<p>Max (2x2 marks)</p>

1	(b)	<p>Give two reasons why it would be helpful to include traffic lights and an audible warning when the bollard is operating.</p> <p>Guidance for Markers The candidate is expected to give two responses, these will generally be associated with:</p> <ul style="list-style-type: none"> • Warning bus drivers • Warning other drivers • Warning pedestrians • Drawing attention to the bollard • Indicating the state of the bollard <p>Examples</p> <p>Weak Response (1) mark Eg. To warn the driver it is operating.</p> <p>Good Response (2) marks, includes clarification Eg. To pre warn the driver of the state of the bollard so they do not drive into it.</p> <p>Weak Response (1) mark Eg. To warn pedestrians.</p> <p>Good Response (2) marks, includes clarification Eg. So pedestrians are warned even if they are not looking in that direction.</p>	<p>Max (2x2 marks)</p>
---	-----	---	---------------------------------------

<p>1</p>	<p>(c)</p>	<p>The bollard should only be operated by drivers of buses. Use notes and sketches to show two different methods of achieving this.</p> <p>Guidance for Markers The candidate is expected to give two responses, these might reference:</p> <ul style="list-style-type: none"> • Coded wireless • Keypad • Magnetic card • Key • Swipe card • Ultrasonic • Infrared • Etc <p>Answers should</p> <ul style="list-style-type: none"> ▪ Give two different systems ▪ Explain method of Input ▪ Explain why only suitable for bus drivers operation ▪ Communicate clearly by notes and sketches <p>Marks awarded as follows for each system</p> <p>A high level response with a full and comprehensive explanation of the system. Response well-structured with good use of appropriate design and technology terminology and sketches. (4 marks)</p> <p>A medium level response with a good explanation of some aspects of the system, however with some aspects of the operation omitted. Response fairly well structured with some use of design and technology terminology and sketches. (3 marks)</p> <p>A low level response with a limited explanation of the system. Response poorly structured with little or no use of design and technology terminology and sketches that add little to the explanation. (2 marks)</p> <p>An attempt at a response, no relevant description presented. No use of design and technology terminology, sketches of limited use for understanding. (1 mark)</p> <p><i>If a system uses a characteristic of the bus for activation (not the driver as mentioned in the question) maximum (3 marks)</i></p>	<p>Max (2 x 4 marks)</p>
----------	------------	--	---

1	(d)		<p>Explain which of your methods in (c) is best, giving reasons for your choice.</p> <p>Marks awarded as follows</p> <p>Weak Response (1) mark Eg. Wireless because it can be used from a distance and the control can be fitted into the bus.</p> <p>Strong Response (2) marks, includes clarification Eg. Wireless because it can be used from a distance and the control can be fitted into the bus. A coded signal is used that cannot be operated by anyone else.</p>	Max (2 Marks)
Qu.	Part	Sub Part	Marking Guidance	Marks
2	(a)		<p>This question is about the design of the bollard. Suggest a suitable material for the bollard and give two reasons for your choice.</p> <p>Marks awarded as follows</p> <p>Suitable Material</p> <p>Should be suitable for the making into required shape and capable of forming a barrier to motor vehicles</p> <p>Eg. Aluminium, stainless steel, steel, composite material, named timber etc (1) mark</p> <p>Reasons</p> <p>These can be related to the situation, forces, manufacturing method, environment etc.</p> <p>Eg. Strength, non-corrosive etc (1) mark Readily available (1) mark Can be machined or joined (1) mark Can be coated for protection (1) mark Etc.</p> <p>Only accept cost is qualified by a comparison</p>	(3 x 1 Mark)

2

(b)

A motor is used to raise and lower the bollard.
Complete the circuit below to show how a relay could be used to reverse the direction of the motor.

(6 Marks)

Marks awarded as follows

A set of switch contacts drawn for the relay (1 mark)

OR

A suitable switch (DPDT) contact drawn (2 marks)

The motor connected to the power source (1 mark)

OR

Motor connected to power via relay contacts (2 marks)

Motor will rotate in one direction when switch A open, stops when closed. (1 mark)

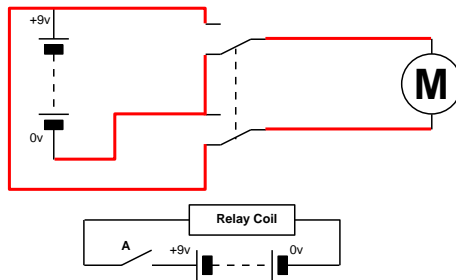
OR

Motor reverses direction when switch A closed (2 marks)

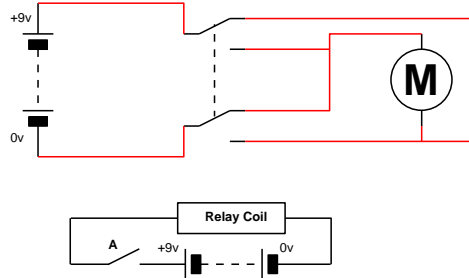
(6 Marks)

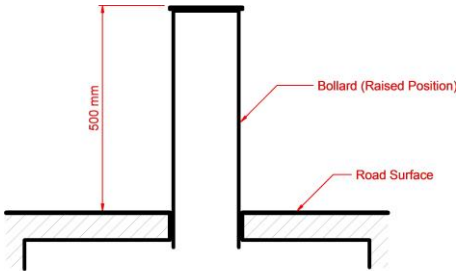
If no separation of the motors power supply and the relay coils power supply maximum (1 mark)

Example 1

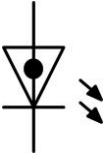
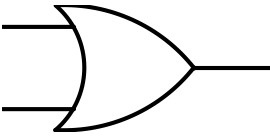
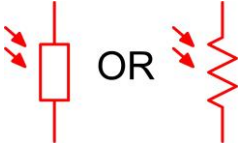
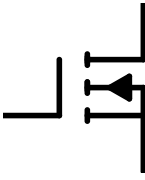
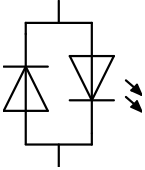

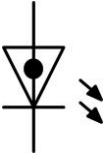
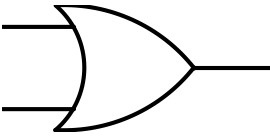
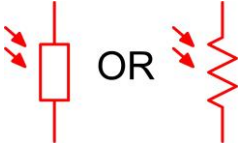
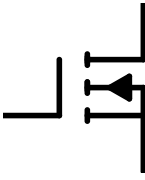
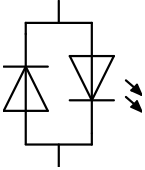

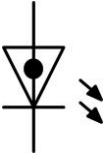
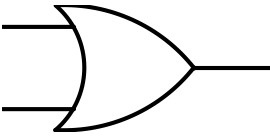
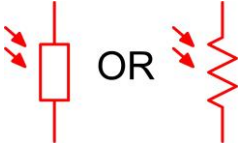
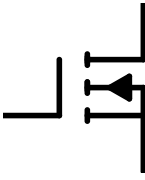
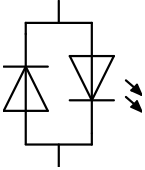



Example 2



<p>2</p>	<p>(c)</p>	<p>When the bollard is in the raised position, its top is 500mm above the road surface. On the diagram below draw a system to raise and lower the bollard that is driven by a motor. (4 Marks)</p>  <p>Marks awarded as follows</p> <p>Suitable method of converting rotary to linear in this situation (1) mark Eg. Screw thread, cam, crank and slider, rack and pinion etc.</p> <p>Bi-directional movement capability shown (1) mark</p> <p>Capable of fully retracting the bollard (1) mark</p> <p>Suitably connected to the bollard (1) mark</p> <p style="text-align: right;">Max (4 Marks)</p>
<p>2</p>	<p>(d)</p>	<p>When the bus has passed over and is clear of the bollard it activates the system to raise the bollard.</p> <p>Suggest a suitable sensor and show where and how it might be mounted to ensure reliable operation.</p> <p>Eg. Pressure sensor, mounted in the road, bus length after the bollard, requires force exerted by weight of bus</p> <p>Marks awarded as follows</p> <p>Suitable sensor for detecting bus (1) mark A sensor like an LDR must have an identifiable input source – eg light beam</p> <p>A physical method of mounting (1) mark The method of housing/holding the sensor</p> <p>Suitable positioning of mount (1) mark At least a bus length after bollard, and suitable for activation by bus</p> <p>How reliable activation is achieved (1) mark How activation by only buses is achieved</p> <p style="text-align: right;">Max (4 marks)</p>

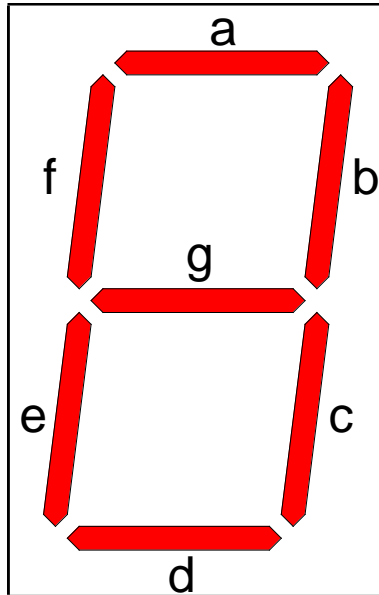
Section B

Qu.	Part	Sub Part	Marking Guidance	Marks																					
3	(a)		<p>This question is about component identification and use.</p> <p>(a) Complete the table below giving the component symbol, component name and the electronic building block where it would be used.</p> <p>Some parts of the table have been completed for you.</p> <table border="1"> <thead> <tr> <th>Component symbol</th> <th>Component name</th> <th>Input – Process - Output</th> </tr> </thead> <tbody> <tr> <td>  </td> <td> Flashing LED (1 mark) </td> <td> Output </td> </tr> <tr> <td>  </td> <td> OR Gate (1 mark) </td> <td> Process (1 mark) </td> </tr> <tr> <td>  </td> <td> Light Dependent Resistor </td> <td> Input (1 mark) </td> </tr> <tr> <td>  </td> <td> FET Or Field Effect Transistor (1 mark) </td> <td> Process (1 mark) </td> </tr> <tr> <td>  </td> <td> Bi-colour LED (1 mark) </td> <td> Output </td> </tr> <tr> <td>  </td> <td> Buzzer </td> <td> Output (1 mark) </td> </tr> </tbody> </table>	Component symbol	Component name	Input – Process - Output		Flashing LED (1 mark)	Output		OR Gate (1 mark)	Process (1 mark)		Light Dependent Resistor	Input (1 mark)		FET Or Field Effect Transistor (1 mark)	Process (1 mark)		Bi-colour LED (1 mark)	Output		Buzzer	Output (1 mark)	<p>Max (10 marks)</p>
Component symbol	Component name	Input – Process - Output																							
	Flashing LED (1 mark)	Output																							
	OR Gate (1 mark)	Process (1 mark)																							
	Light Dependent Resistor	Input (1 mark)																							
	FET Or Field Effect Transistor (1 mark)	Process (1 mark)																							
	Bi-colour LED (1 mark)	Output																							
	Buzzer	Output (1 mark)																							

3 (b)

For the 7 Segment LED shown in diagram below, which segments are lit to display the number 2 and 5?

Seven Segment Display



Marks awarded as follows

Number 2:
Segments:a,b,g, (1 mark) d,e (1 mark)
[more than 5 segs 0]

Number 5:
Segments:a,f,g (1 mark) c,d (1 mark)
[more than 5 segs 0]

**Max
(2 x 2
marks)**

4 (a)

This question is about using logic networks to make decisions.
 If inputs A, B, and C are all in the high state.
 Tick the correct box to show the logic state at the **three** positions indicated on the logic network below.

High
 Low

High
 Low

High
 Low

A **B** **C** **Q**

Each correct response (1 mark)

Max (3 marks)

4 (b)

Complete the truth table for the following circuit

A	B	C	X
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	1

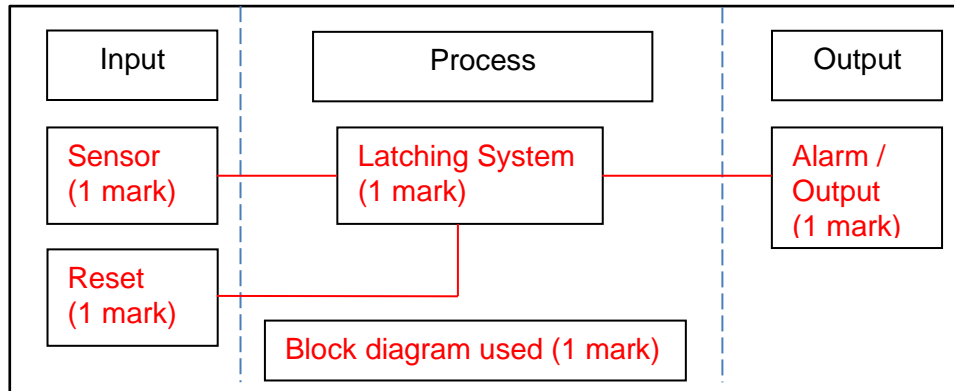
Each correct pair as indicated on truth table (1 mark)

Max (4 marks)

5	(a)	(i)	<p>This question is about property security. Identify one weak point on a house where an intruder may try to gain unwanted entry.</p> <p>Window OR Door (1 mark)</p>	(1 mark)
5	(a)	(ii)	<p>Suggest two methods of sensing unwanted entry for the above. For each system give a reason for your choice.</p> <p>Monitoring systems such as cameras are not acceptable</p> <p>Marks awarded as follows</p> <p>Sensing System 1:...Eg. Reed Switch and Magnet (1) mark</p> <p>Reason 1:</p> <p>Weak Response (1) mark Eg. Easy to fit or readily available</p> <p>Strong Response (2) marks, includes clarification Eg. The magnet can be fitted to the window and the reed switch attached to the frame making it easier to wire up.</p> <p>OR If the magnet is moved away from the reed switch, the switch will change and set off the alarm.</p> <p>Sensing System 2:...Eg. Light sensor and beam (1) mark</p> <p>Reason:</p> <p>Weak Response (1) mark Eg. Anyone entering would break the beam (1) mark</p> <p>Strong Response (2) marks, includes clarification Eg. The light beam could be positioned so that any intruder had to break it when opening the door.</p>	<p>Max (2 x 3 marks)</p>

5 (b)

In the space below draw a system block diagram to show a method of making a house alarm **latch on**, and how the system can be reset.



The above example is one of many possible solutions, the latching function could also be shown by the use of feedback. Candidates will also be rewarded if they use the names of suitable component (eg. Thyristor for latching)

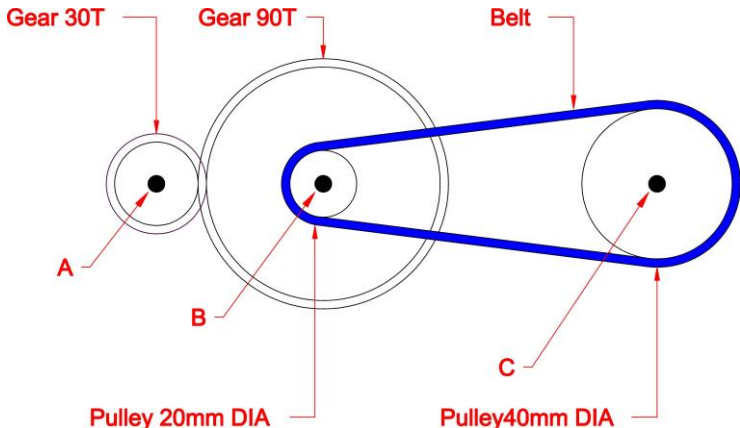
Marks awarded as follows

- A systems block diagram (1 mark)
- A suitable activation method under input (1 mark)
- A suitable Reset system under input (1 mark)
- A reference to the alarm under output (1 mark)
- Reference to a method of latching under process (1 mark)
- The blocks correctly connected –

**Max
(5 marks)**

<p>5</p>	<p>(c)</p>	<p>Give two specification points for the external case that holds the house alarm.</p> <p>Answers could reference:</p> <p>Cost, strength, security, manufacturing method, environment, material properties Etc</p> <p>Marks awarded as follows</p> <p>Point 1:Weak Response (1) mark Should be waterproof</p> <p>Strong Response (2) marks Should be waterproof because it will be outside and needs to protect the siren or electrical circuit</p> <p>Point 2: Weak Response (1) mark Should be strong</p> <p>Strong Response (2) marks Should be difficult for an intruder to smash or damage.</p>	<p>Max (2 x 2 marks)</p>
<p>6</p>	<p>(a)</p>	<p>This question is about manufacturing methods. Using notes and sketches explain how you can produce a precise right angled bend in 2mm thick sheet material. Name the material you have chosen.</p> <p>Marks awarded as follows:</p> <p>Clear drawing aiding understanding (1) mark</p> <p>Reference to suitable material for the process (1) mark</p> <p>Clear explanation of the process (1) mark</p> <p>Reference to how appropriate force is applied to achieve 90 degrees bend (1) mark OR method of joining if fabricated</p> <p>Reference to using square / jig / fixture to ensure Right angled bend (1) mark</p> <p><i>If solution is fabricated not bent maximum (4 marks)</i></p>	<p>Max (5 marks)</p>

<p>6</p>	<p>(b)</p>	<p>Describe how two pieces of aluminium sheet can be joined, using a method which allows them to be taken apart when required. You may use notes or sketches to support your answer.</p> <p><i>If the parts are not held firmly in contact maximum (1 mark)</i></p> <p>Suitable methods include: nut and bolt, rivet, cramping system, shaping of material to form a mechanical joint, etc. The description should include a description of assembly and disassembly for full marks.</p> <p>Marks awarded as follows Eg. Nut and Bolt -Answer could be written or diagrams</p> <p>Weak Response (1 mark) Use a nut and bolt – or diagram of nut and bolt</p> <p>Good Response (2 marks) A hole is required through both pieces of sheet, the nut and bolt goes through the hole and holds them together.</p> <p>Strong Response (3 marks) A hole is required through both pieces of sheet, the nut and bolt goes through the hole and holds them together. The nut and bolt can be easily removed to take the sheets apart.</p>	<p>Max (3 marks)</p>
----------	------------	--	---------------------------------

7	(a)	(i)	<p>This question is about the transmission of motion. The diagram shows a transmission system where the 20mm diameter pulley and the 90 teeth gear are both attached to shaft B.</p>  <p>Shaft A rotates in a clockwise direction.</p> <p>Tick the boxes below for the correct answers for parts (i) and (ii)</p> <p>Shaft B rotates clockwise anticlockwise.</p> <p style="text-align: center;"> <input type="checkbox"/> <input checked="" type="checkbox"/> (1 mark) </p>	(1 mark)
7	(a)	(ii)	<p>Shaft C rotates clockwise anticlockwise.</p> <p style="text-align: center;"> <input type="checkbox"/> <input checked="" type="checkbox"/> (1 mark) </p>	(1 mark)
7	(b)	(i)	<p>If shaft A rotates at 12 rpm, calculate the speed of rotation of shafts B and C.</p> <p>Marks awarded as follows</p> <p>Correct Formula (1) (using words or actual values)</p> <p>12 / Correct Formula (1)</p> <p>Speed of shaft B 4 OR 4 rpm (1)</p>	Max (3 marks)
7	(b)	(ii)	<p>Correct Formula (1) (using words or actual values)</p> <p>Answer from Part (i) / Correct Formula (1 mark)</p> <p>Speed of shaft C...2 OR 2 rpm (1 mark)</p> <p>OR</p> <p>correct calculation of above formula</p>	Max (3 Marks)

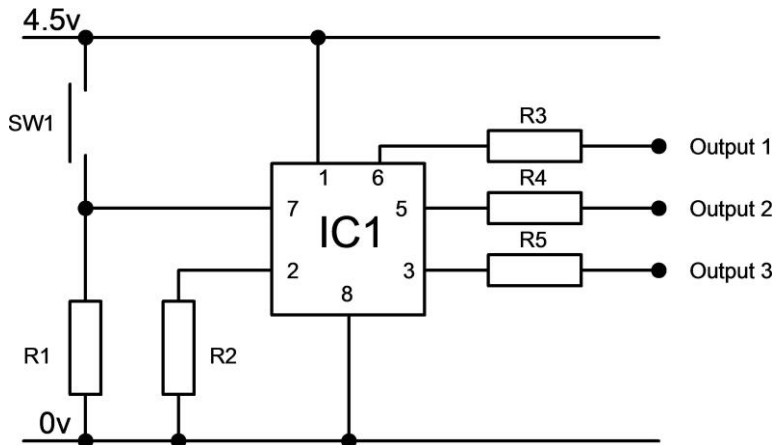
<p>7</p>	<p>(c)</p>	<p>Explain one advantage and one disadvantage of using a belt to transmit motion.</p> <p>Advantages Allows transmission over long distances, easily manufactured therefore cheaper, Can slip under excessive loads this can be used as a safety feature, Tend to be quieter than gear systems etc</p> <p>Marks awarded as follows</p> <p>Example (1 mark) with explanation (2 marks)</p> <p>Disadvantage Can slip so cannot be used for heavy loads or precise movement, susceptible to dirt and oil, belt needs additional support and tensioning especially if used over long distances, Belts wear and need replacing etc</p> <p>Marks awarded as follows</p> <p>Example (1 mark) with explanation (2 marks)</p>	<p>Max (2 x 2 marks)</p>
<p>7</p>	<p>(d)</p>	<p>A method is required to drive a small air pump from a motor.</p> <p>Draw a system for converting the output of the motor to reciprocating motion. For each rotation of the motor 60mm of reciprocating motion should be produced.</p> <p>Marks awarded as follows</p> <p>Reference to input / motor / motor driving system (1) mark Eg. Motor labelled and attached to crank</p> <p>System for conversion to reciprocating motion (1) mark Eg. Crank and slider, eccentric, peg and slot, cam and follower (only if return system for follower – gravity or spring), , etc</p> <p>Output guided (1) mark Eg. A guidance system is indicated that ensures the output is reciprocating not oscillatory</p> <p>Dimensions indicated (1) correct for 60mm movement (2) marks Eg. The candidate may give the diameter of the crank as 60mm but not the throw as 60mm.</p> <p>Clear drawing aiding understanding (1) mark Eg. Should show the main parts of the system, their interconnections and pivot points.</p>	<p>Max (6 marks)</p>

<p>8</p>		<p>Explain the advantages to a manufacturer of using CAD (Computer Aided Design) and CAM (Computer Aided Manufacture) when producing products in batches.</p> <p>Eg. Companies can improve accuracy, quality, speed of production, adapt products more quickly, use machines for more than one product, change production quickly, high initial cost but greater flexibility, lower overall costs, repeatability of products and batches</p> <p>Marks awarded as follows</p> <p>A high level response with a full and comprehensive explanation of most aspects of using CAD/CAM for batch production. Response well-structured with good use of appropriate design and technology terminology and showing a good grasp of grammar, punctuation and spelling. To achieve full marks the response must reference repeatability. (7 - 8marks)</p> <p>A medium level response with a good explanation of some aspects of using CAD/CAM for batch production, however with some aspects of the advantages omitted. Response fairly well structured with some use of design and technology terminology with a small number of errors in grammar, punctuation. (5 - 6 marks)</p> <p>A low level response with a limited explanation of two aspects of using CAD/CAM for batch production with several errors. Response poorly structured with little or no use of design and technology terminology and with several errors in grammar, punctuation and spelling. (3 - 4 marks)</p> <p>An attempt at a response, no relevant description presented. No use of design and technology terminology and multiple errors in grammar, punctuation and spelling. (1 - 2 marks)</p>	<p>Max (8 marks)</p>
-----------------	--	--	---------------------------------

9 (a)

This question is about the production of a musical three note door-bell using a microcontroller.

The circuit below controls the three outputs of the door-bell

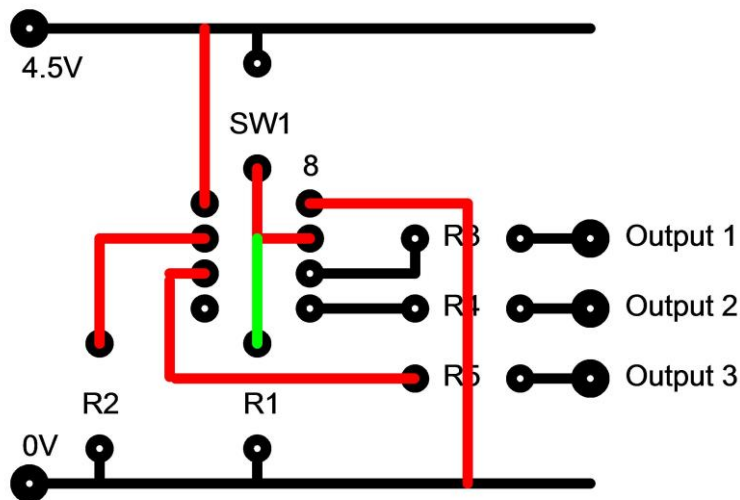


Complete the missing **six** PCB tracks on the PCB layout for the circuit above.

Do not let the tracks cross.

The pads and some of the tracks have been completed for you.

PCB Layout



Marks awarded as follows

Each correct interconnection (1 mark)

No mark for interconnection if it crosses another track

**Max
(6 marks)**

9 (b)

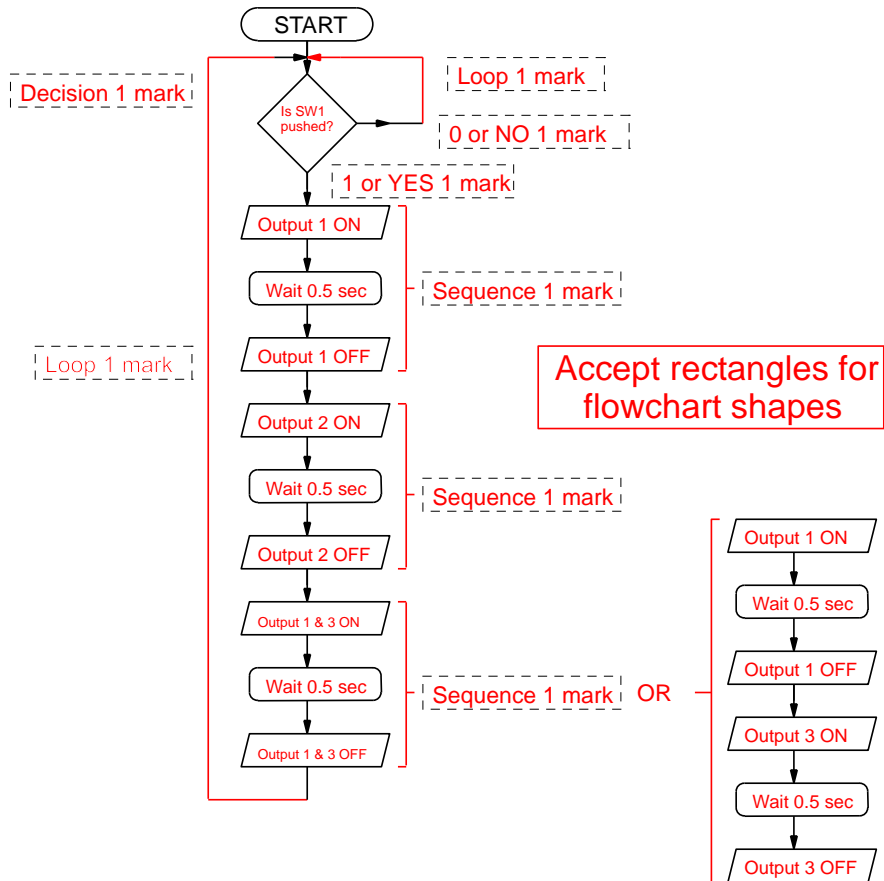
The three outputs connect to a separate musical note generating system. The door-bell operates in the following way:

- The notes should play in the sequence 1, 2, 1 & 3.
- Each note should only play for 0.5 seconds
- The sequence should start when switch 1 is pressed
- The sequence should continue until switch 1 is released

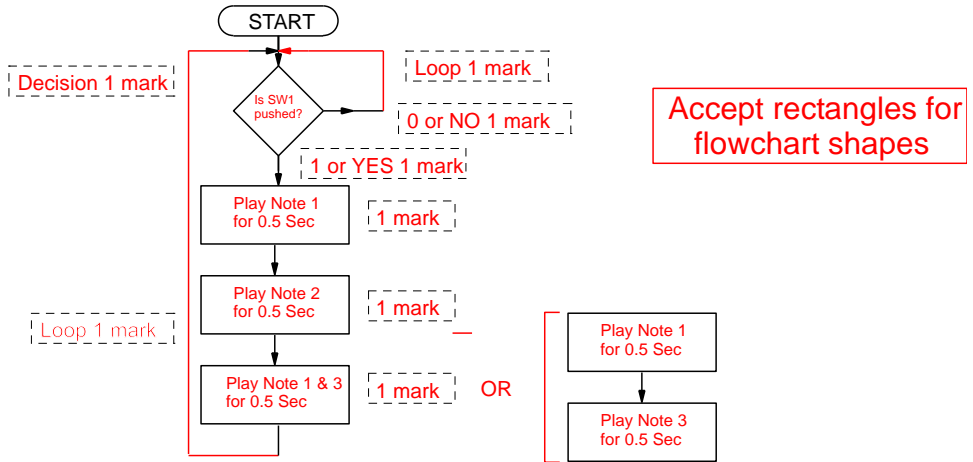
Draw a flowchart to show how this door-bell is controlled.

Marks awarded as indicated on the flowchart above

Example 1



Example 2



Max
(8 Marks)