AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

GCSE

DESIGN AND TECHNOLOGY: SYSTEMS AND CONTROL TECHNOLOGY

Unit 1 Written Paper

Tuesday 24 May 2016 Morning Time allowed: 2 hours

Materials

For this paper you must have:
- a black pen
- a pencil
- a ruler
- an eraser
- a pencil sharpener.

Instructions
- Use black ink or black ball-point pen. Use pencil only for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this answer book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 120.
- Section A relates to the context given in the Preliminary Material that was previously issued.
- You are reminded of the need for good English and clear presentation in your answers. Quality of Written Communication will be assessed in Question 8.
- You may use a calculator.

You may need to use one or more of the following formulae when answering questions which include calculations.

Potential Difference $V = I \times R$

Series Resistance $R_T = R_1 + R_2$

Potential Divider $\text{Voltage 1} = \frac{R1}{R1 + R2} \times \text{Supply Voltage}$

$\text{Voltage 2} = \frac{R2}{R1 + R2} \times \text{Supply Voltage}$

Ratio of Simple Gears $\text{Gear ratio} = \frac{\text{Number of teeth on driven gear}}{\text{Number of teeth on driver gear}}$

Velocity Ratio $\text{Velocity ratio} = \frac{\text{Diameter of driven pulley}}{\text{Diameter of driver pulley}}$

$\text{Output speed} = \frac{\text{Input Speed}}{\text{Gear / Velocity ratio}}$

Mechanical Advantage $MA = \text{Load / Effort}$

Section A

Answer **all** questions in the spaces provided.

You are advised to spend about 20 minutes on this question.

1 This question is about the design of a traffic control system using a bollard.

Study the photographs below. These show the operation of a bollard that allows access for buses.

Showing bollard fully raised

Showing bollard fully lowered

1 (a) Give **two** reasons why the bollard system shown on page 3 is a suitable method of controlling traffic in a public area.

[4 marks]

Reason 1: _____

_____

_____

_____

Reason 2: _____

_____

_____

_____

1 (b) Give **two** reasons why it would be helpful to include traffic lights and an audible warning when the bollard is operating.

[4 marks]

Reason 1: _____

_____

_____

_____

Reason 2: _____

_____

_____

_____

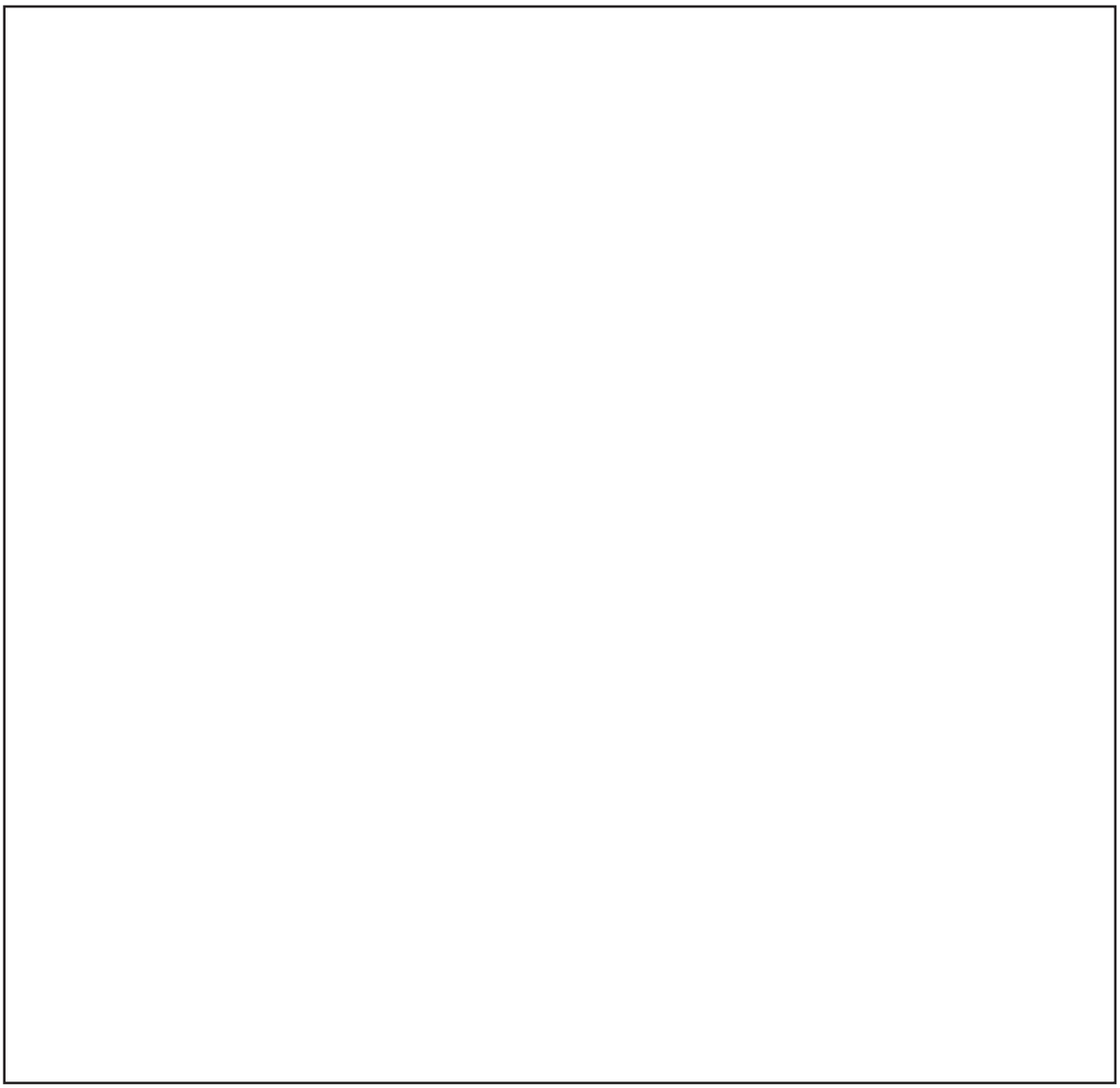
1 (c) The bollard should **only** be operated by drivers of buses.

Use notes and sketches to show **two** different methods of achieving this.

[8 marks]

Method 1

Method 2



1 (d) Explain which of your methods in part (c) is best and give reasons for your choice.

[2 marks]

You are advised to spend about 15 minutes on this question.

2 This question is about the design of the bollard.

2 (a) Suggest a suitable material for the bollard and give **two** reasons for your choice.

[3 marks]

Material _____

Reason 1: _____

_____

_____

Reason 2: _____

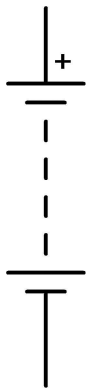
_____

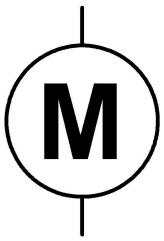
_____

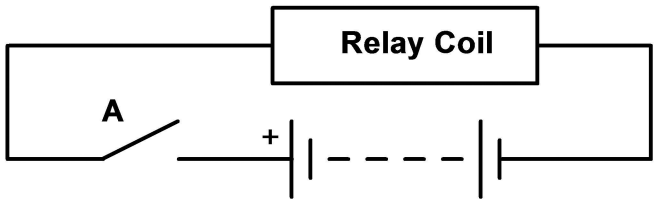
2 (b) A motor is used to raise and lower the bollard.

Complete the circuit below to show how a relay could be used to reverse the direction of the motor.

[6 marks]



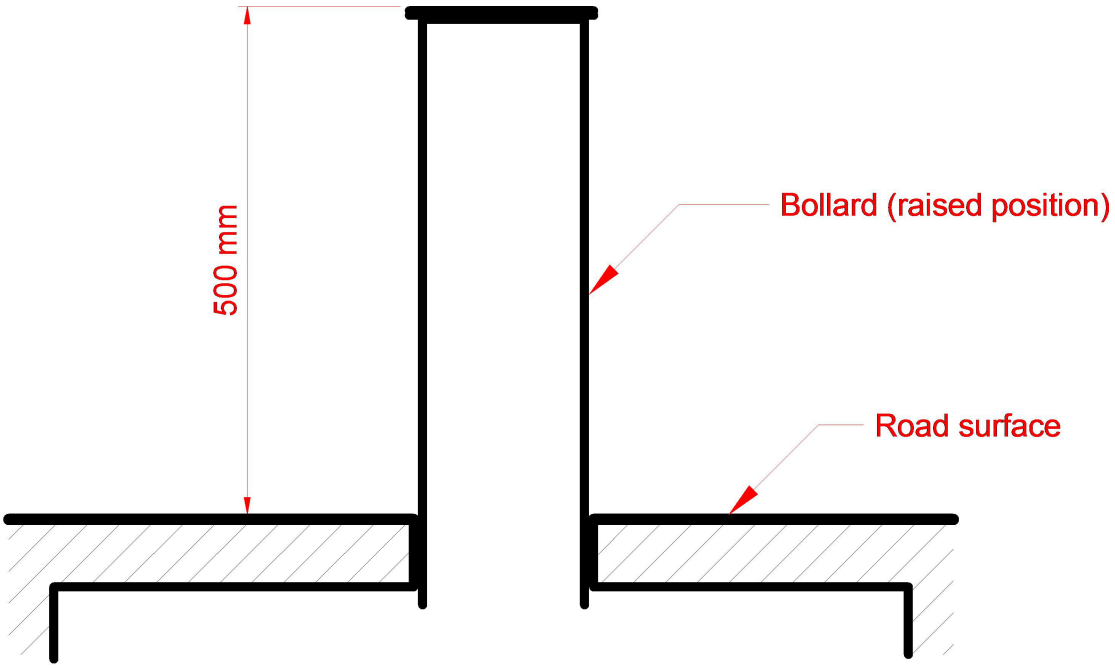




2 (c) When the bollard is in the raised position, its top is 500 mm above the road surface.

On the diagram below draw a system to raise and lower the bollard that is driven by a motor.

[4 marks]



2 (d) When the bus has passed over and is clear of the bollard, it activates the system to raise the bollard.

Suggest a suitable sensor and show where and how it might be mounted to ensure reliable operation.

[4 marks]

17

Section B

Answer **all** questions in the spaces provided.

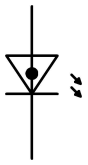
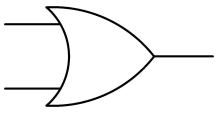
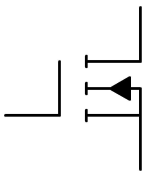
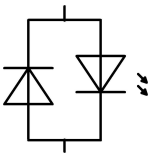
You are advised to spend about 15 minutes on this question.

3 This question is about component identification and use.

3 (a) Complete the table below giving the component symbol, component name and the electronic building block where it would be used.

Some parts of the table have been completed for you.

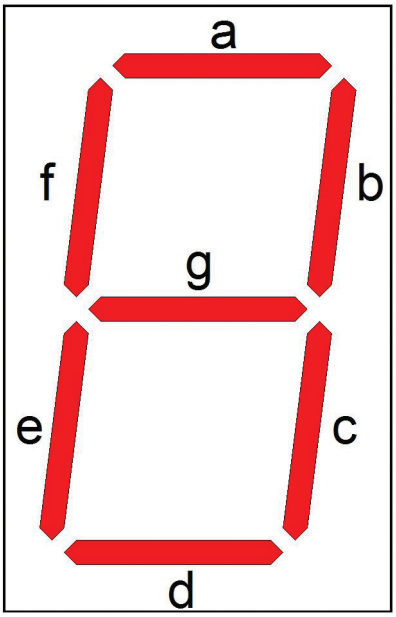
[10 marks]

Component symbol	Component name	Input – Process – Output
		Output
		
	Light Dependent Resistor	
		
		Output
	Buzzer	

3 (b) For the Seven Segment LED display shown below, which segments are lit to display the number '2' and the number '5'?

[4 marks]

Seven Segment Display



Number 2:

Segments: _____

Number 5:

Segments: _____

14

Turn over for the next question

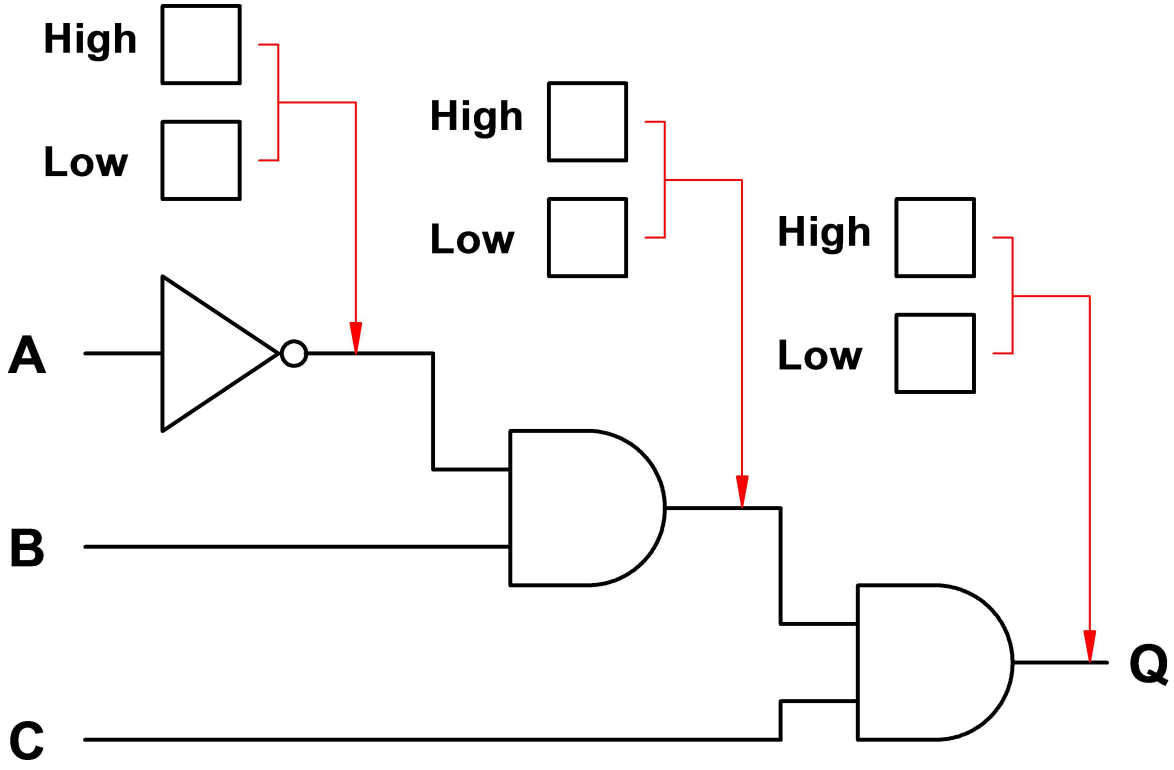
You are advised to spend about 5 minutes on this question.

4 This question is about using logic networks to make decisions.

4 (a) Inputs **A**, **B**, and **C** are all in the high state.

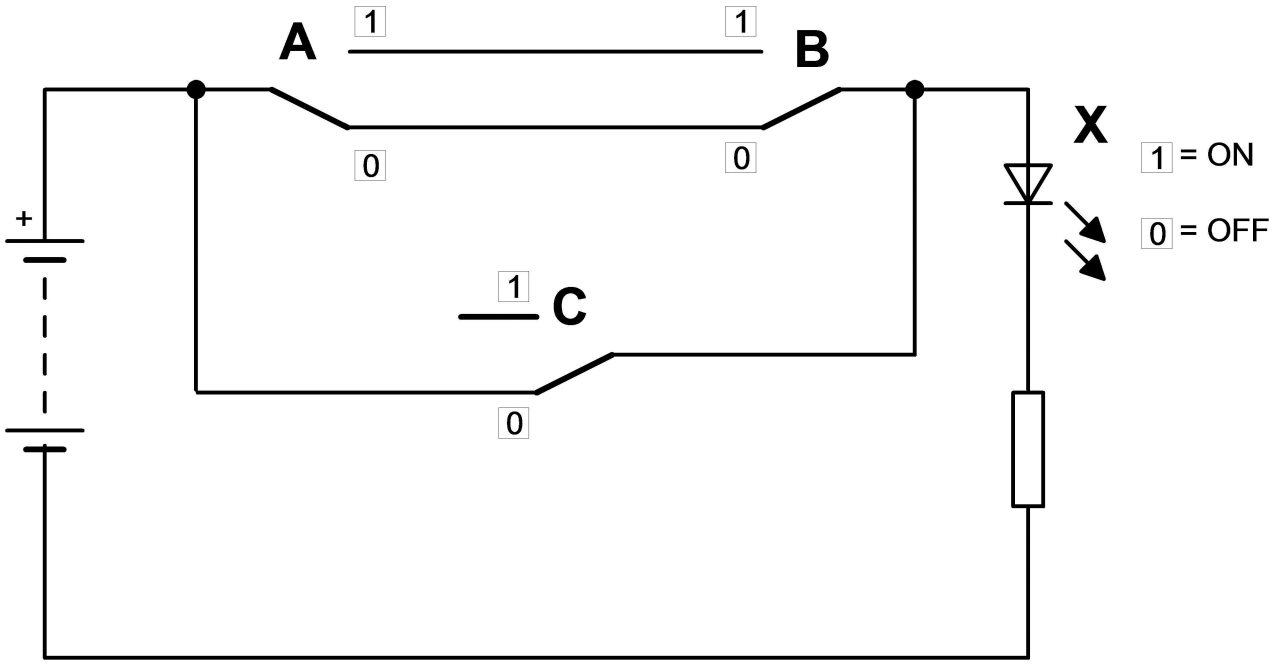
Tick the correct box to show the logic state at the **three** positions indicated on the logic network below.

[3 marks]



4 (b) Complete the truth table for the following circuit.

[4 marks]



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

7

You are advised to spend about 15 minutes on this question.

5 This question is about property security.

5 (a) (i) Identify **one** weak point on a house where an intruder may try to gain unwanted entry.

[1 mark]

_____

5 (a) (ii) Suggest **two** methods of sensing unwanted entry for the above.

For each system give a reason for your choice.

[6 marks]

Sensing System 1: _____

_____

_____

Reason: _____

_____

_____

_____

Sensing System 2: _____

_____

_____

Reason: _____

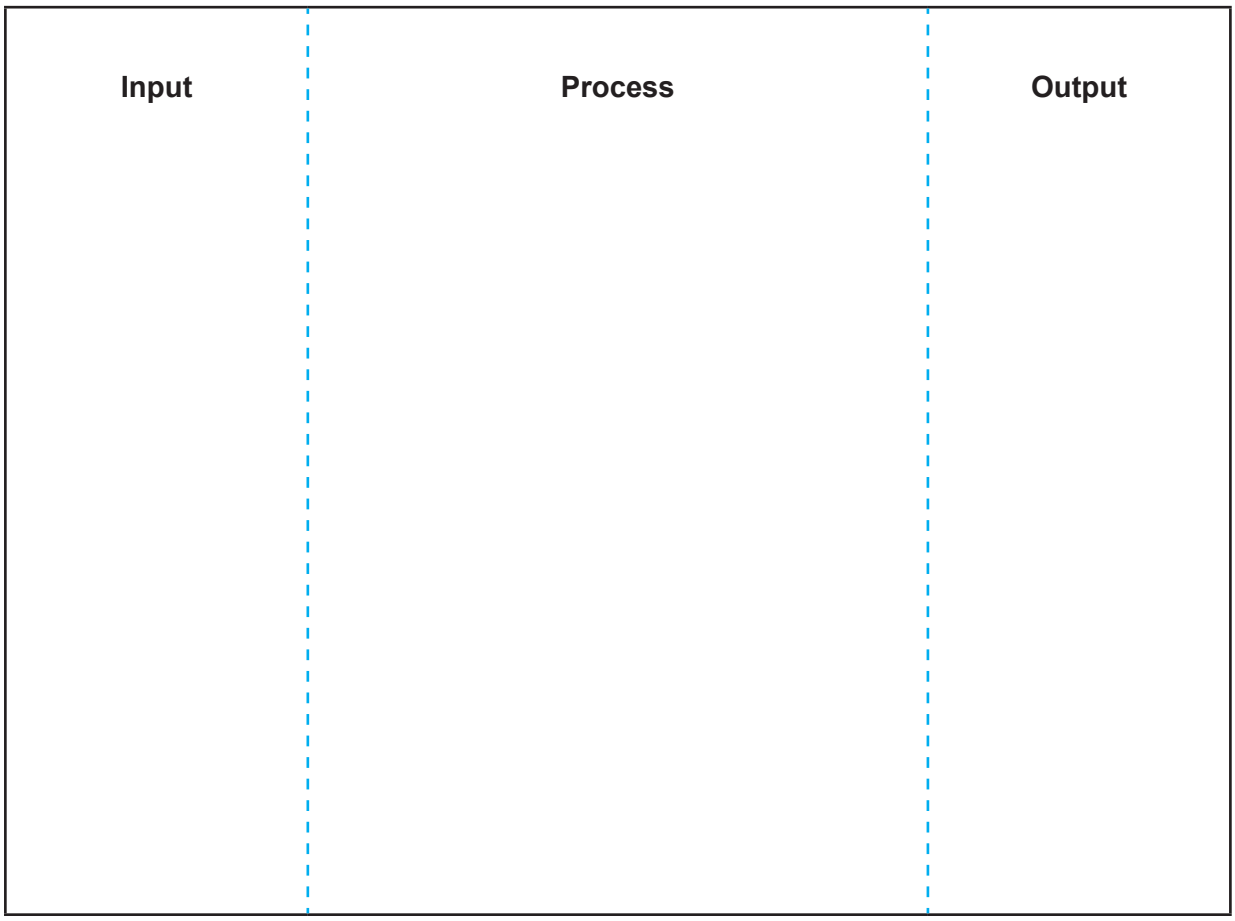
_____

_____

_____

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.

[5 marks]



5 (c) Give **two** specification points for the external case that holds the house alarm.

[4 marks]

Point 1: _____

_____

_____

_____

Point 2: _____

_____

_____

_____

16

You are advised to spend about 10 minutes on this question.

6 This question is about manufacturing methods.

6 (a) Using notes and sketches explain how you can produce a precise right angled bend in 2 mm thick sheet material. Name the material you have chosen.

[5 marks]

6 (b) 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.

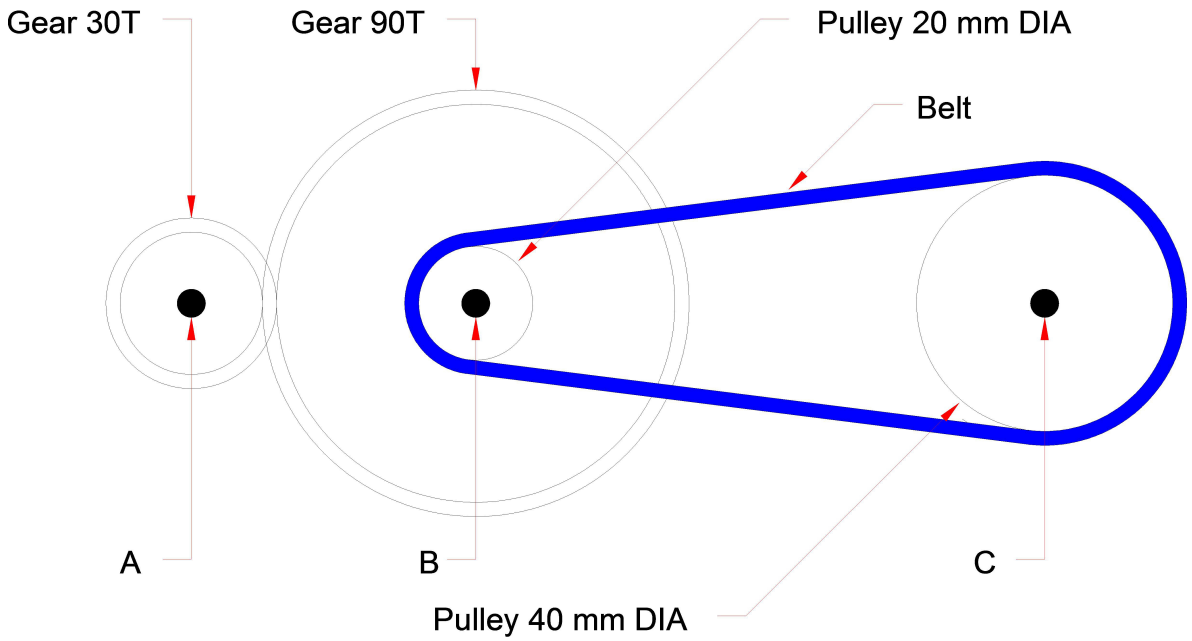
[3 marks]

8

You are advised to spend about 20 minutes on this question.

7 This question is about the transmission of motion.

The diagram shows a transmission system where the 20 mm diameter pulley and the 90 teeth gear are both attached to shaft B.



7 (a) Shaft A rotates in a clockwise direction.

Tick the boxes below for the correct answers for parts (i) and (ii)

7 (a) (i) Shaft B rotates clockwise ☐ anticlockwise ☐ **[1 mark]**

7 (a) (ii) Shaft C rotates clockwise ☐ anticlockwise ☐ **[1 mark]**

7 (b) (i) If shaft A rotates at 12 rpm, calculate the speed of rotation of shaft B.

[3 marks]

Speed of shaft B _____

7 (b) (ii) If shaft A rotates at 12 rpm, calculate the speed of rotation of shaft C.

[3 marks]

Speed of shaft C _____

7 (c) Explain **one** advantage and **one** disadvantage of using a belt to transmit motion.

[4 marks]

Advantage _____

Disadvantage _____

7 (d) A method is required to drive a small air pump from a motor.

Draw a system for converting the output of the motor to reciprocating motion.
For each rotation of the motor 60 mm of reciprocating motion should be produced.

[6 marks]

18

You are advised to spend about 5 minutes on this question.

8 Explain the advantages to a manufacturer of using CAD (Computer Aided Design) and CAM (Computer Aided Manufacture) when producing products in batches.

You will be tested for Quality of Written Communication in this question.

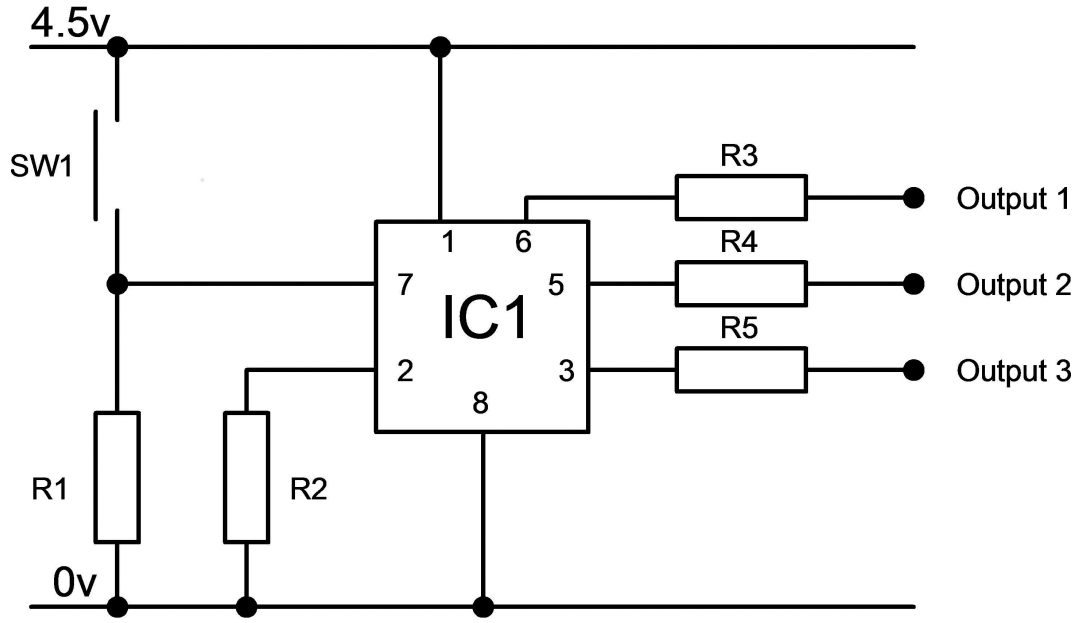
[8 marks]

8

You are advised to spend about 15 minutes on this question.

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

9 (a) The circuit below controls the three outputs of the door-bell.

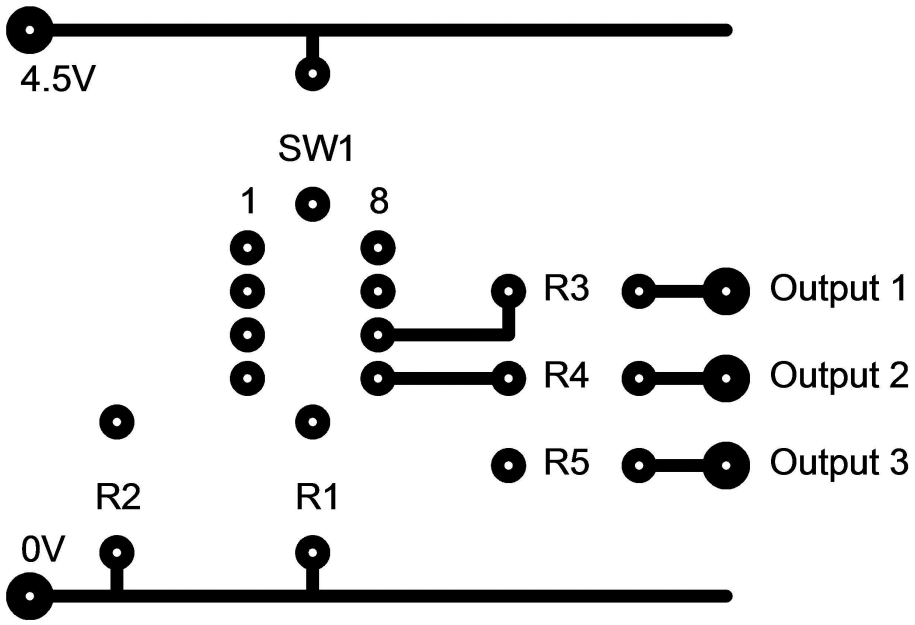


Complete the **six** missing PCB tracks on the PCB layout for the circuit above.

Do not let the tracks cross. The pads and some of the tracks have been completed for you.

[6 marks]

PCB Layout



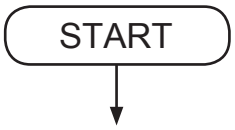
9 (b) The three outputs connect to a separate musical note generating system.

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.

[8 marks]



14

END OF QUESTIONS

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED