

Surname		Other Names	
Centre Number		Candidate Number	
Candidate Signature			

General Certificate of Secondary Education
Summer 2003



**ELECTRONICS
FOUNDATION TIER**

3432/F

Tuesday 3 June 2003 Afternoon Session

In addition to this paper you will require:

- a pencil and a ruler;
- a calculator.

For Examiner's Use			
Number	Mark	Number	Mark
1			
2			
3			
4			
5			
6			
7			
8			
9			
Total (Column 1)	→		
Total (Column 2)	→		
TOTAL			
Examiner's Initials			

Time allowed: 1 hour 30 minutes

Instructions

- Use blue or black ink or a ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** the questions in the spaces provided.
- Show the working of your calculations.

Information

- The maximum mark for this paper is 120.
- Mark allocations are shown in brackets.
- A list of formulae and other information, which you may wish to use in your answers, is provided on page 2.
- You are reminded of the need for good English and clear presentation in your answers.

Information Sheet

The following information may be useful in answering the questions.

1. **Power**

Power = voltage x current; $P = VI$

2. **Amplifiers**

Voltage gain $G_V = \frac{V_{OUT}}{V_{IN}}$

3. **Resistor colour code**

The colours in the resistor colour code correspond to the following values.

BLACK	0	GREEN	5
BROWN	1	BLUE	6
RED	2	VIOLET	7
ORANGE	3	GREY	8
YELLOW	4	WHITE	9

The fourth band colour gives the tolerance.

GOLD $\pm 5\%$ SILVER $\pm 10\%$ No fourth band $\pm 20\%$

4. **Resistor printed code (BS 1852)**

R means $\times 1$

K means $\times 1000$

M means $\times 1\,000\,000$

Position of letter gives the decimal point.

Tolerances are indicated by adding a letter at the end.

J $\pm 5\%$ K $\pm 10\%$ M $\pm 20\%$

e.g. 5K6J = 5.6 k Ω $\pm 5\%$

5. **Preferred values for resistors (E24 SERIES)**

1.0 1.1 1.2 1.3 1.5 1.6 1.8 2.0 2.2 2.4 2.7 3.0 3.3 3.6 3.9 4.3 4.7 5.1 5.6 6.2 6.8 7.5 8.2 9.1
and multiples of ten.

6. Resistance = $\frac{\text{voltage}}{\text{current}}$; $R = \frac{V}{I}$

7. Effective resistance, R, of resistors in series is given by $R = R_1 + R_2 + R_3$.

8. Effective resistance, R, of two resistors R_1 and R_2 in parallel is given by $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$

9. **A.C. waveforms**

(a) Frequency of waveform = $\frac{1}{\text{time period}}$; $f = \frac{1}{T}$

(b) peak value = 1.4 x rms value

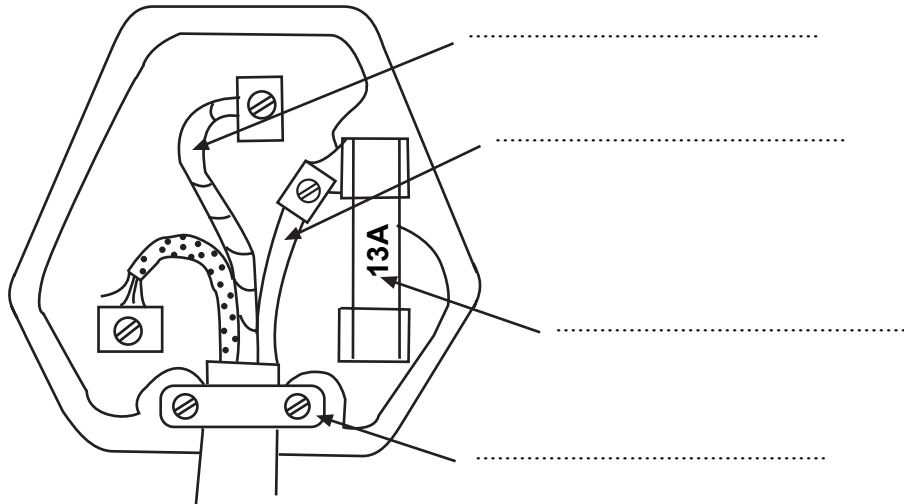
10. **Astable and monostable generators using 555 timers**

(a) Monostable mode, time period $T = 1.1 R_1 \times C_1$

(b) Astable mode, time period $T = \frac{(R_1 + 2R_2) C_1}{1.44}$

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

1 The diagram shows the inside of a mains plug.



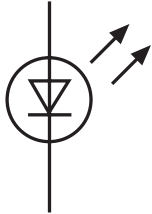
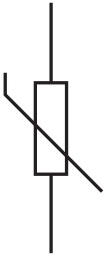

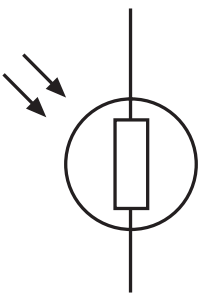

(a) Label on the diagram above: the cord grip
the fuse
the live wire
the earth wire. (4 marks)

(b) What are the colours of:
(i) the earth wire?
(ii) the live wire?
(iii) the neutral wire? (3 marks)

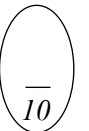
(c) Refer to the diagram above.
(i) Which part of the wired plug is a safety hazard?
.....
(ii) How can this be improved?
.....
(iii) What makes this wired plug unsuitable for a 25 W soldering iron?
.....
..... (3 marks)

Turn over ▶

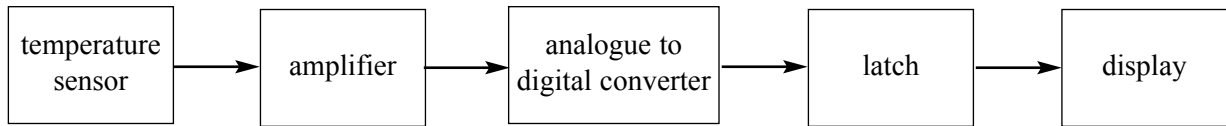
- 2 Name each component symbol shown by completing the name column on every line. Tick **one** of the other columns for each component to show whether the component is an input device or an output device.

Symbol	Name	Input	Output
			
			
			
			
			

(10 marks)



- 3 The diagram shows a digital thermometer system.
It will measure the temperature and show the result on a 7-segment display.



(a) Which block represents:

- (i) an input?
- (ii) an output?
- (iii) an analogue process?
- (iv) a digital process?

(4 marks)

(b) In which block could:

- (i) an op-amp be used?
- (ii) a D-type flip-flop be used?
- (iii) a thermistor be used?

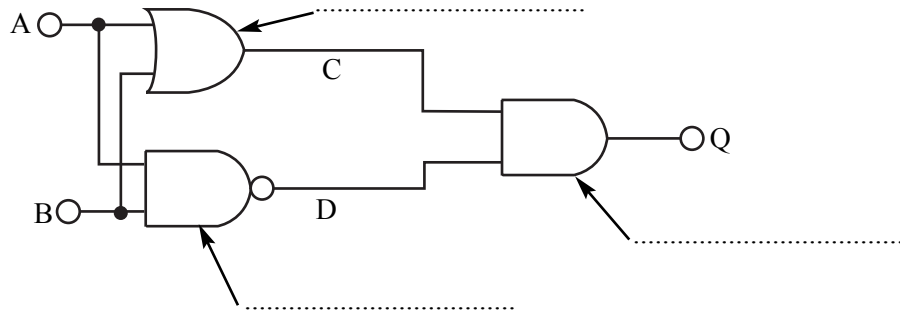
(3 marks)

(c) Which block:

- (i) increases the size of the signal?
- (ii) contains LEDs?
- (iii) is a simple memory?

(3 marks)

4 (a) Label the **three** types of logic gate in the diagram below.



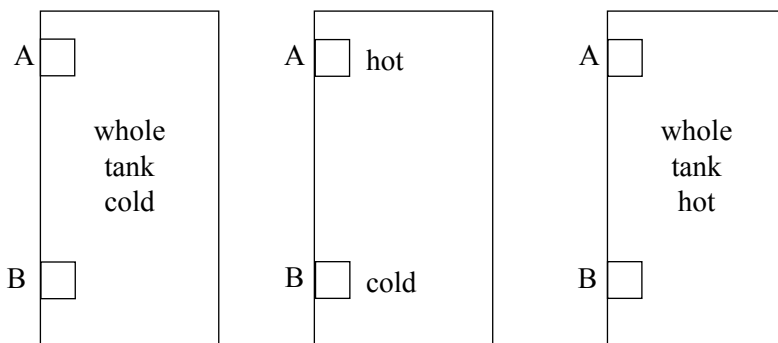
(3 marks)

(b) Complete the truth table below to describe the operation of the logic circuit in part (a).

A	B	C	D	Q
0	0			
0	1			
1	0			
1	1			

(6 marks)

(c) The inputs A and B are connected to temperature sensors.
Hot gives a logic 1 and cold gives a logic 0.
A is at the top of a tank of liquid and B is at the bottom.
Q is connected to a buzzer which sounds when a logic 1 is present.
Put a tick under the tank which will sound the buzzer.

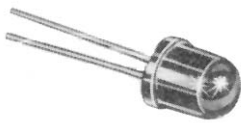


.....

(1 mark)

5 (a) Name and describe the function of the following types of component.

(i)

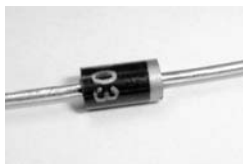


Name

Function

.....

(ii)



Name

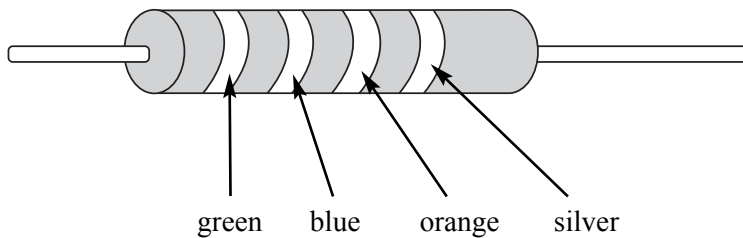
Function

.....

State its forward voltage drop

(5 marks)

(b) Name this component and complete the information below.



Name

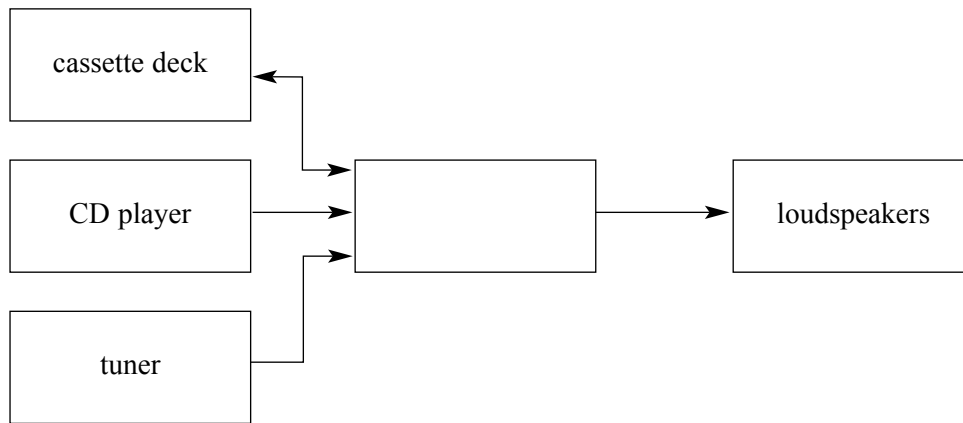
Value

Tolerance

(5 marks)

10

6 A block diagram of a hi-fi system is shown below.



(a) Name the unlabelled block by writing its function in the empty box above. (1 mark)

(b) Which sub-system:

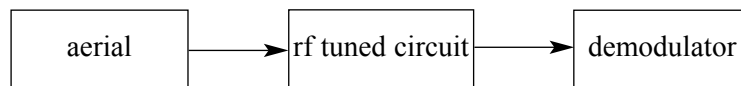
(i) converts electrical signals into sound signals?.....

(ii) can be used to record and playback?.....

(iii) converts signals above 150 kHz into audio signals?

(3 marks)

(c) The tuner could be made from the first three sub-systems of a simple radio receiver shown in the diagram below.



Describe the function of:

(i) the aerial,

.....

(ii) the rf tuned circuit,

.....

(iii) the demodulator.

.....

(6 marks)

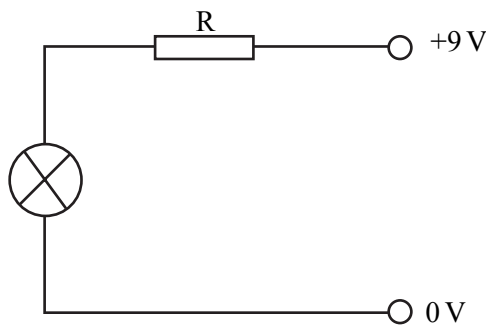
7 (a) Which electronic component can:

- (i) limit current in a circuit?
 - (ii) store charge?
- (2 marks)*

(b) State the unit of:

- (i) power,
 - (ii) frequency.
- (2 marks)*

(c) The lamp in the circuit below has 6 V across it and the current through it is 0.06 A.



(i) State the current through the resistor R.

.....

Calculate, showing your working and the correct units for:

(ii) the voltage across the resistor R,

.....
.....

(iii) the value of resistor R,

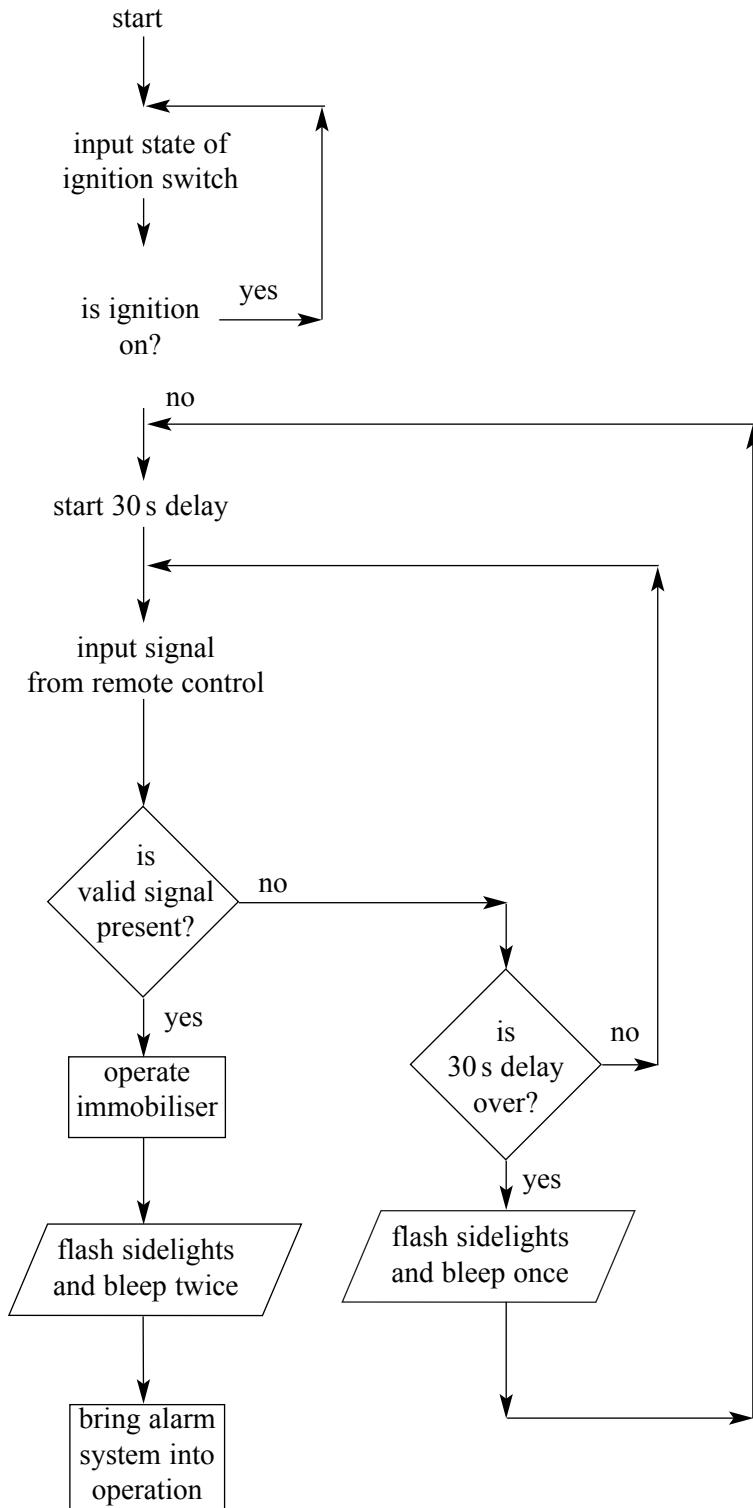
.....
.....

(iv) the power dissipated by the resistor R.

.....
.....

(6 marks)

8 The flowchart describes the operation of a car alarm and immobiliser. Some of the flowchart symbols have been left out.



(a) (i) Draw the correct flowchart symbols where they are missing on the diagram.

(ii) Label on the flowchart:

a decision box

an input box

a loop

an output box

a process box

(10 marks)

- (b) Using the flowchart in part (a), describe the sequence of events that occur in the 60 seconds after the ignition has been switched off and the remote control is not used to operate the system. What purpose might be served by this sequence of events?

.....

.....

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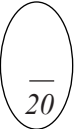
.....

.....

(5 marks)

- (c) Using the flowchart in part (a) as a guide, draw a new flowchart to describe the part of the alarm system that would detect anyone entering the car. The system should give a short delay before sounding an audible alarm and flashing lights. While the delay is operating it should be possible to switch the alarm system off using the remote control.

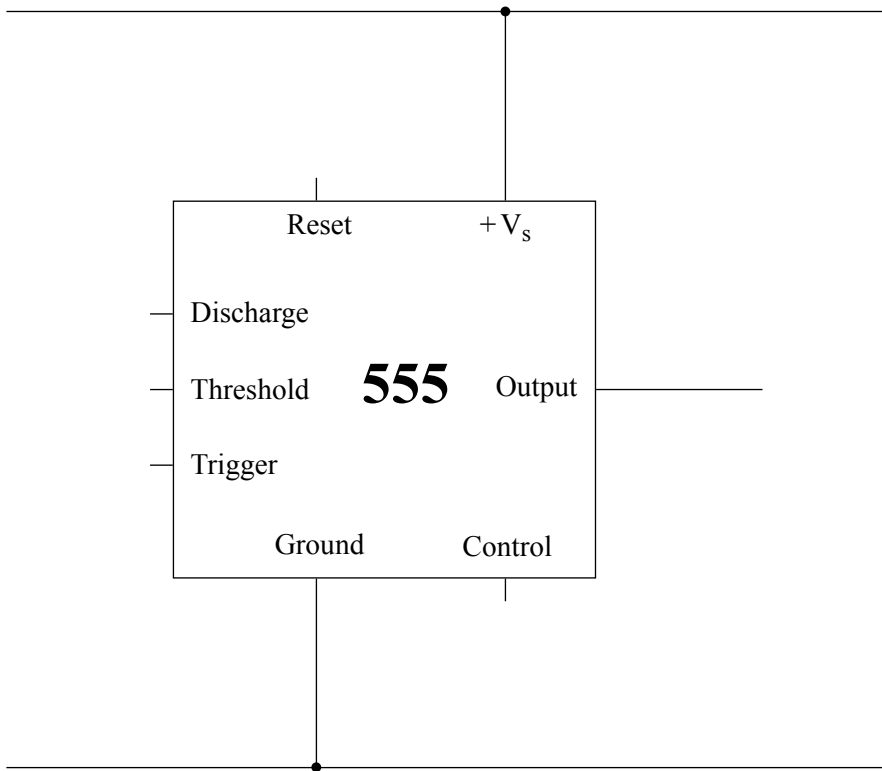
(5 marks)



Turn over ▶

9 A student makes an electronic doorbell system for the front and back doors of a house. The system is designed to make a different sequence of sounds depending on which switch is pressed. People in the house would then know which door to open.
Part of the system is an astable using a 555 timer IC which provides pulses to a 4017 counter IC.

- (a) Complete the diagram below to show how a 555 timer IC is connected as an astable. On the diagram, draw **two** resistors, **two** capacitors and wire links to complete it.



(6 marks)

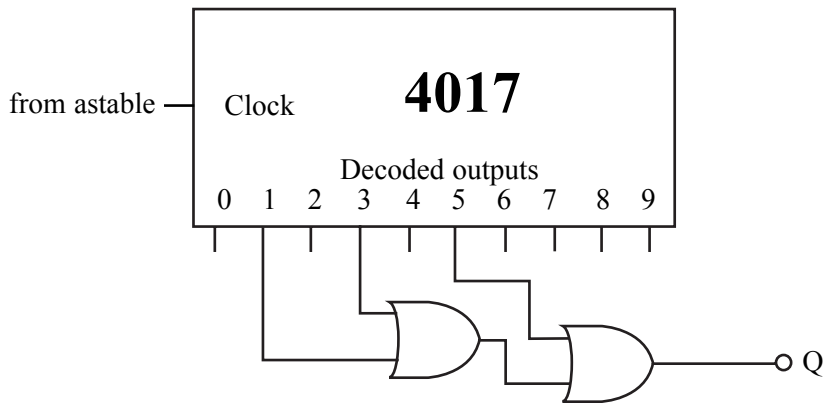
- (b) (i) The 4017 counter has ten decoded outputs. Describe what happens to the logic levels at these outputs as pulses are fed into its clock input.

.....

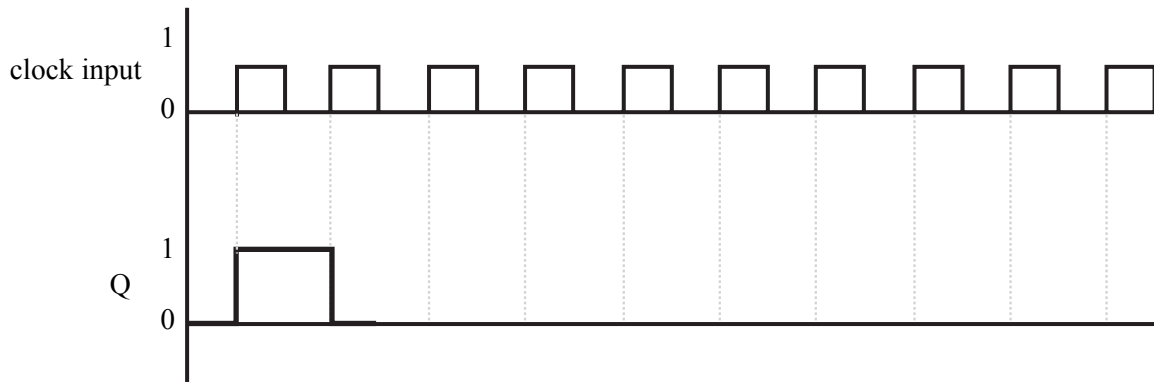
.....

.....

(ii) Logic gates are connected to some of the 4017 outputs as on the diagram below.



Complete the timing diagram below to show the output from Q as pulses are fed into the clock input.



(iii) The logic output Q controls a buzzer, describe the pattern of sound made when the system operates.

.....

.....

.....

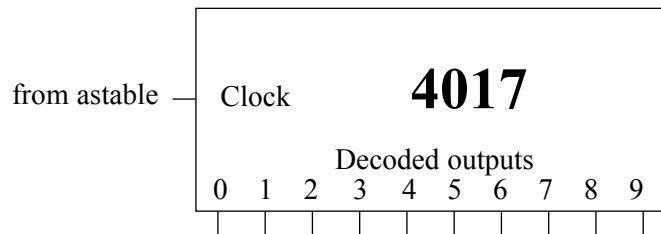
QUESTION 9 CONTINUES ON THE NEXT PAGE

Turn over ►

- (iv) To make a different pattern of sound from the buzzer a different logic system is needed. Draw a logic diagram to show how to make the following pattern of sound:

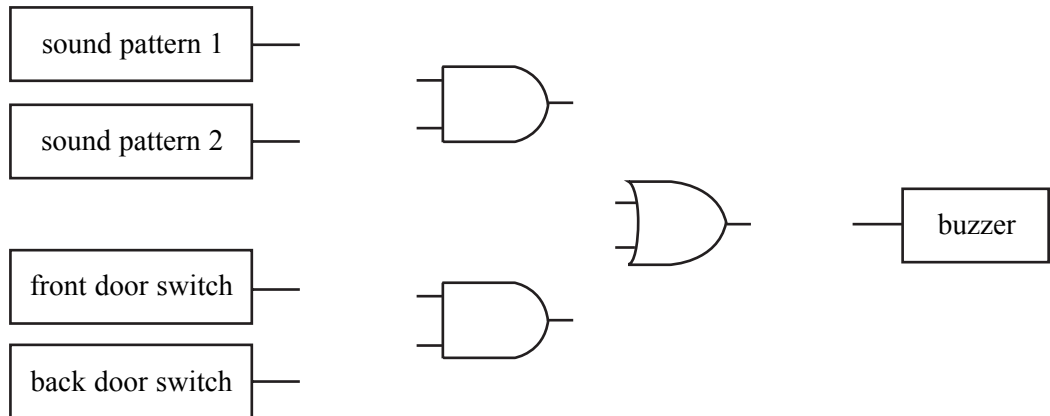
short buzz, short gap, longer buzz, longer gap.

A 4017 IC diagram has been drawn for you to add suitable logic gates.



(12 marks)

- (c) (i) Each output from the logic system in part (b) opposite must only be sent to the buzzer when the relevant doorbell is pressed. Complete the diagram below showing how the gates and sub-systems are connected.



- (ii) This system still has one problem in that pressing either switch for a short time may give no output at all. Explain why this is and suggest a way of solving this problem.

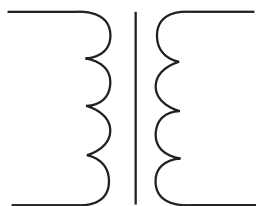
.....

(6 marks)

- (d) The electronic doorbell system operates from the mains supply using a transformer. Which component can:

- (i) rectify the transformer output?.....
 (ii) smooth the rectified output?.....
 (iii) stabilise the smoothed output?
- (iv) Draw below a labelled circuit diagram of a suitable rectified, smoothed, regulated power supply that would operate from the transformer secondary.

Transformer



(6 marks)