

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
GCSE

A515/01

DESIGN AND TECHNOLOGY
Electronics and Control Systems

**Sustainability and technical aspects of designing
and making – Electronics**

FRIDAY 23 MAY 2014: Afternoon

**DURATION: 1 hour 30 minutes
plus your additional time allowance**

MODIFIED ENLARGED

Candidate forename		Candidate surname	
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Centre number						Candidate number				
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Candidates answer on the Question Paper.

OCR SUPPLIED MATERIALS:

None

OTHER MATERIALS REQUIRED:

A calculator may be used for this paper.

Pencil

Ruler (cm/mm)

A CALCULATOR MAY BE USED FOR THIS PAPER
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READ INSTRUCTIONS OVERLEAF

INSTRUCTIONS TO CANDIDATES

Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes on the first page.

Use black ink. Pencil may be used for graphs and diagrams only.

Read each question carefully and make sure you know what you have to do before starting your answer.

Answer ALL the questions in Section A AND Section B.

Write your answer to each question in the space provided, however additional paper may be used if necessary.

Show all working out for calculations.

INFORMATION FOR CANDIDATES

Your quality of written communication is assessed in questions marked with an asterisk (*).

The number of marks for each question is given in brackets [] at the end of the question or part question.

Dimensions are in millimetres unless stated otherwise.

The total number of marks for this paper is 80.

Any blank pages are indicated.

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SECTION A

Answer ALL questions.

You are advised to spend 40 minutes on this section.

On questions 1–5 circle your answer.

1 Using natural gas central heating contributes to:

(a) Carbon credits

(b) Improving your loft insulation

(c) Global warming

(d) Carbon dioxide reduction

[1]

2 For maximum efficiency, wind turbines should face:

(a) Directly into the wind

(b) South

(c) Sideways on to the wind

(d) Towards the sun

[1]

3 The Forest Stewardship Council:

- (a) Manufactures wooden patio furniture**
- (b) Promotes the responsible management of the world's forests**
- (c) Issues tree preservation orders**
- (d) Encourages people to use wood-burning stoves [1]**

4 The Eco-footprint of a product is:

- (a) Easy to clean off floors**
- (b) How much carbon dioxide is caused by the production and use of the product**
- (c) Information about how to return a faulty product**
- (d) How much it costs the consumer to buy [1]**

- 5 Secondary recycling of an electronic product means:**
- (a) Re-using the materials in different products**
 - (b) Dumping the waste in a landfill site**
 - (c) Using a product twice before throwing it away**
 - (d) Donating the item to a charity shop [1]**
- 6 Which of the 6Rs describes choosing not to buy a product?**
- _____ [1]
- 7 State the name of a smart material.**
- _____ [1]
- 8 Give ONE reason why electronic waste may be harmful to humans.**
- _____
- _____ [1]
- 9 Give ONE method of gathering anthropometric data.**
- _____ [1]

10 Complete the following to give the meaning of the abbreviation LCA.

L _____ C _____ Analysis [1]

Decide whether the statements below are TRUE or FALSE.

Tick (✓) the box to show your answer.

TRUE FALSE

11 Carbon offsetting means moving your e-waste to another country ☐ ☐ [1]

12 Workers in a sweatshop are well paid ☐ ☐ [1]

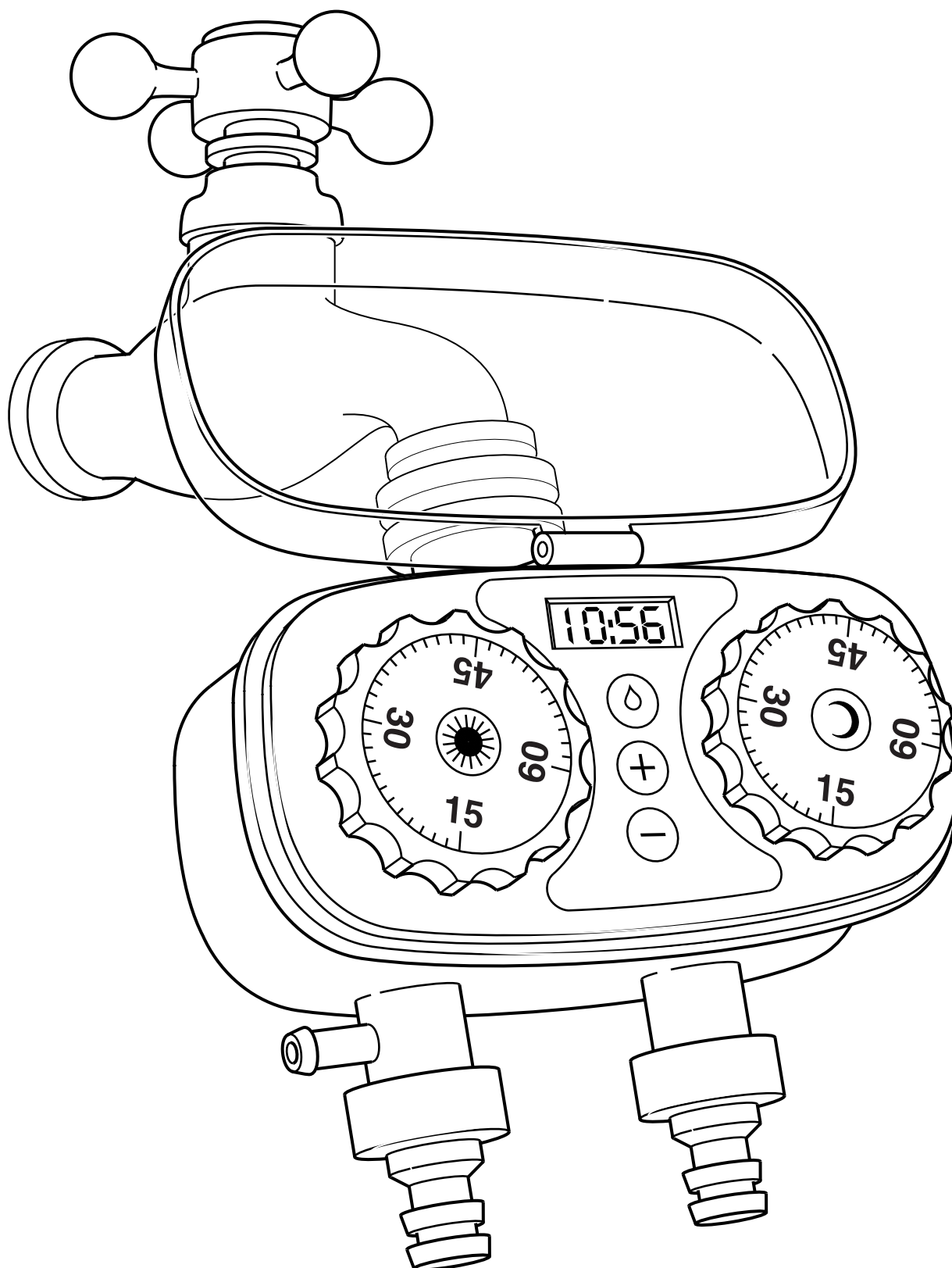
13 LED lamps are energy efficient ☐ ☐ [1]

14 NiMH cells contain mercury ☐ ☐ [1]

15 CFC means Chloro Fluoro Carbon ☐ ☐ [1]

16 Fig. 1 shows a garden watering controller.

Fig. 1



(a) Identify THREE design features of the garden watering controller shown in Fig. 1.

1 _____

2 _____

3 _____

[3]

(b) The garden watering controller is powered by four AA alkaline cells.

Give TWO environmentally friendly improvements that could be made to this power system.

1 _____

2 _____

[2]

(c) Identify ONE sustainable method of disposing of AA alkaline cells.

_____ **[1]**

- (d) The garden watering controller is supplied in clear plastic packaging.**

Give TWO reasons why the manufacturer may have chosen to use clear plastic packaging.

1 _____

2 _____

[2]

- (e) Explain the disadvantages to the environment of using plastic packaging.**

[3]

- (f) Use sketches and notes to show THREE pieces of information which could be found on the product packaging.**

[3]

(g)* Discuss ways that electronic products can help to save water and energy. [6]

[illegible]

[TOTAL: 35]

SECTION B

Answer ALL questions.

You are advised to spend 50 minutes on this section.

17 (a) External components often require fitting through holes cut into a casing.

A key switch and a potentiometer are ready to be fitted to the front plate of a prototype case shown in Fig. 2. The dimensions of the holes required are also shown.

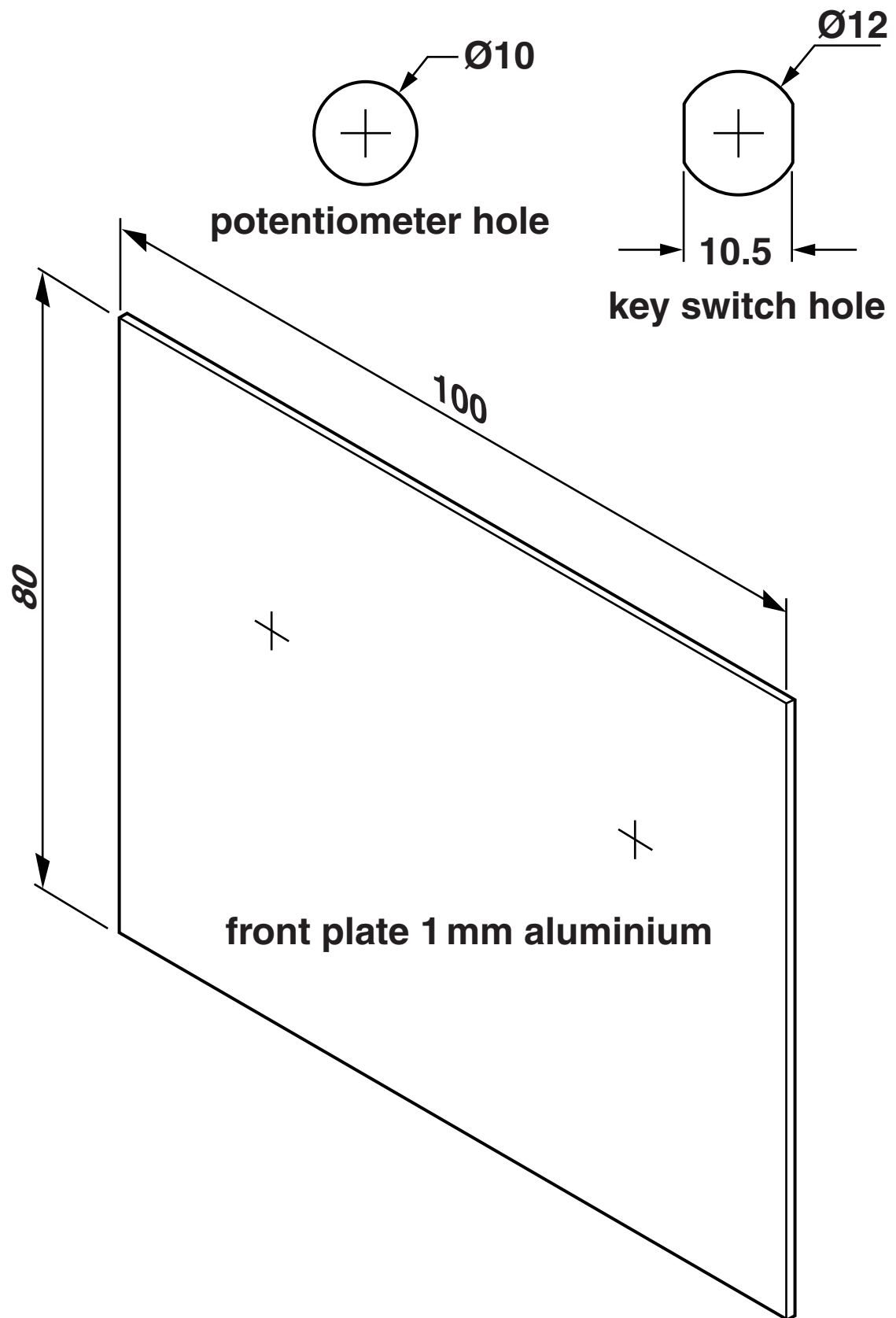
(i) Give ONE method of accurately marking the hole outlines on the front plate.

_____ [1]

(ii) Explain why there are ‘flats’ on the key switch hole but not on the potentiometer hole.

_____ [2]

Fig. 2



- (iii) Use sketches and notes to describe how the hole for the key switch can be accurately cut in the aluminium front plate using hand tools.**

Name the tools used.

[3]

- (iv) In production, both holes would be made by a punch tool.
Give TWO advantages of using a punch tool for producing holes in sheet metal.

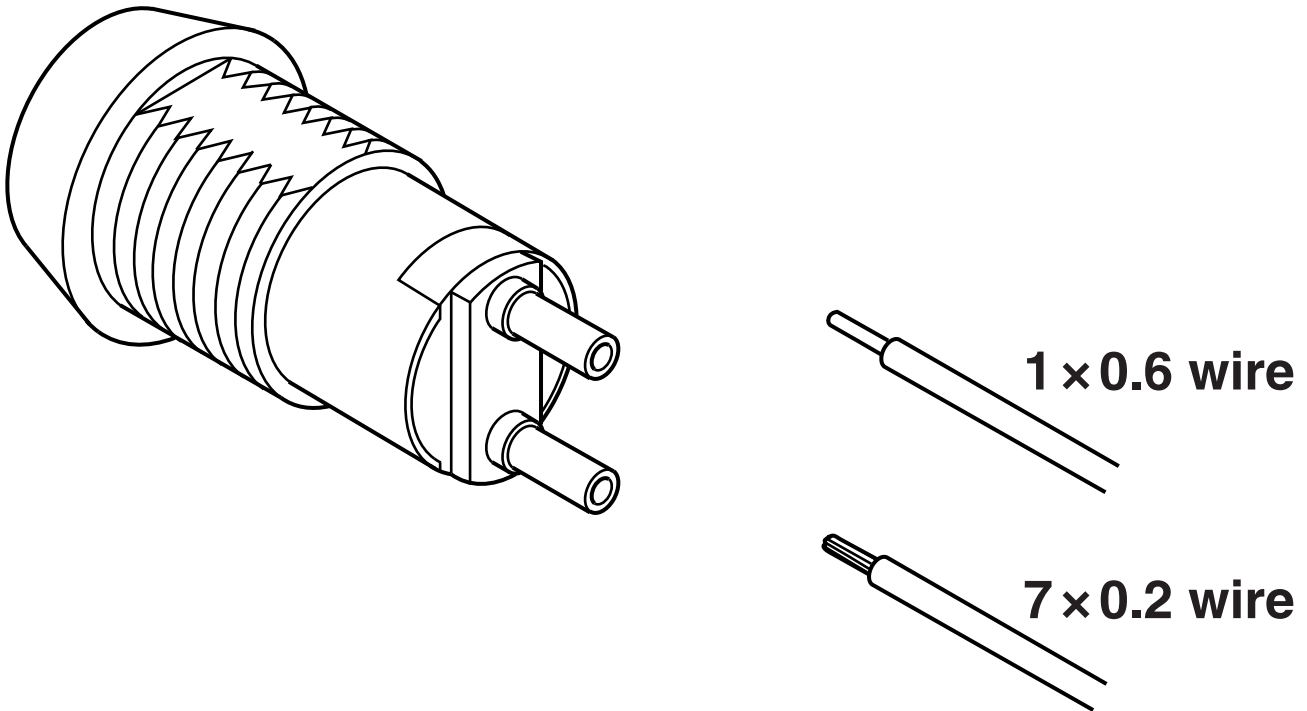
1 _____

2 _____

[2]

- (b) Fig. 3 shows the terminals of the key switch with two types of wire that could be used for the connection.

Fig. 3



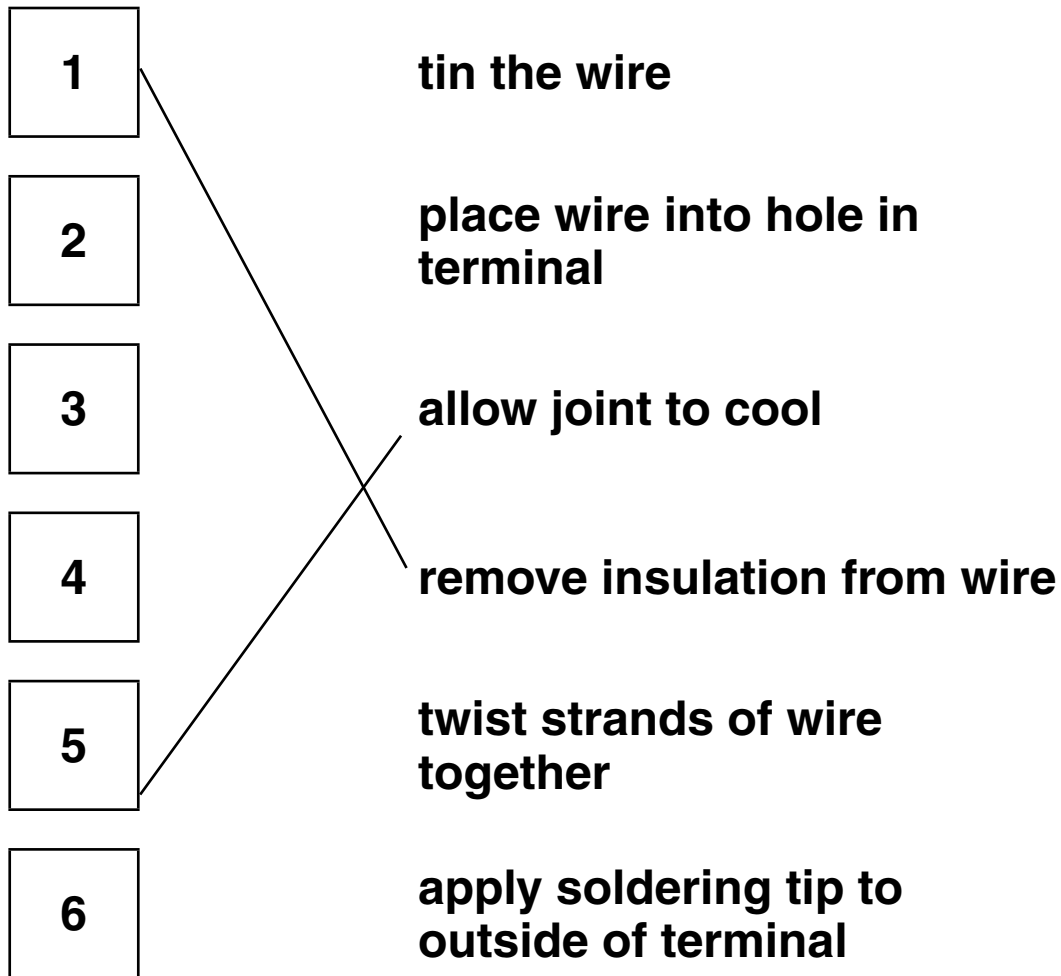
- (i) State the reason for using 7×0.2 wire rather than 1×0.6 wire.

_____ [1]

- (ii) Complete Fig. 4 to show the correct order for processes in soldering the connection wires in place.

Fig. 4

order of processes



[4]

(c) The potentiometer has a value of $2\text{ M}\Omega$ marked on it.

The tolerance of this type of potentiometer is $\pm 20\%$.

State the range that can be expected for the maximum value of resistance.

between _____ Ω

and _____ Ω .

[2]

[TOTAL: 15]

- 18 Many electronic devices to deter animals from going into gardens rely on high frequency sound that is audible to the animal but not to humans. Fig. 5 shows a table of approximate hearing range for an animal deterrent device.**

Fig. 5

Hearing range	Frequency	
	Low	High
cat	30 Hz	50 kHz
dog	50 Hz	46 kHz
rabbit	300 Hz	45 kHz
rat	1 kHz	60 kHz
human	20 Hz	17 kHz

(a) Fig. 6 gives details of four speaker units.

- (i) Choose the most suitable speaker unit for use in an animal deterrent device.**

_____ **[1]**

- (ii) Give ONE reason for your choice.**

_____ **[1]**

Fig. 6

Description	Speaker diameter	Waterproof	Frequency range	Price
seawater resistant speaker	100 mm	yes	60 Hz –15 kHz	£10.95
waterproof full range speaker	64 mm	yes	200 Hz – 20 kHz	£4.75
piezo ultrasonic tweeter	40 mm	yes	2500 Hz – 45 kHz	£3.45
mini speaker with plastic diaphragm	50 mm	no	180 Hz –17 kHz	£1.45

- (b) The high frequency sound will be in the form of a square wave.
 Fig. 7a shows an astable circuit that will produce a square wave output.

Fig. 7a

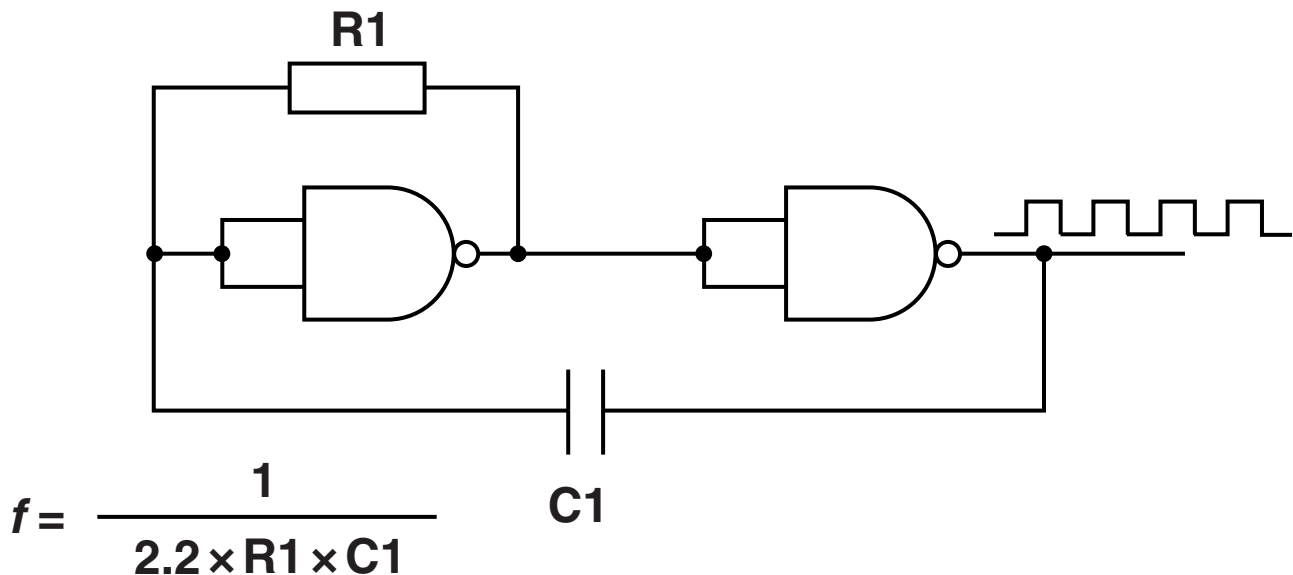
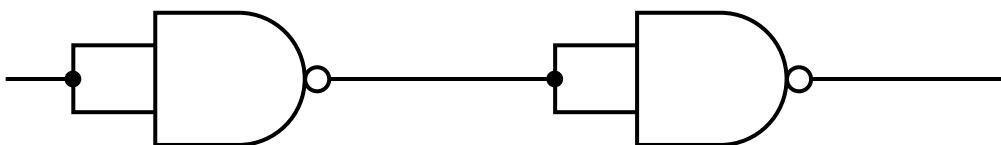
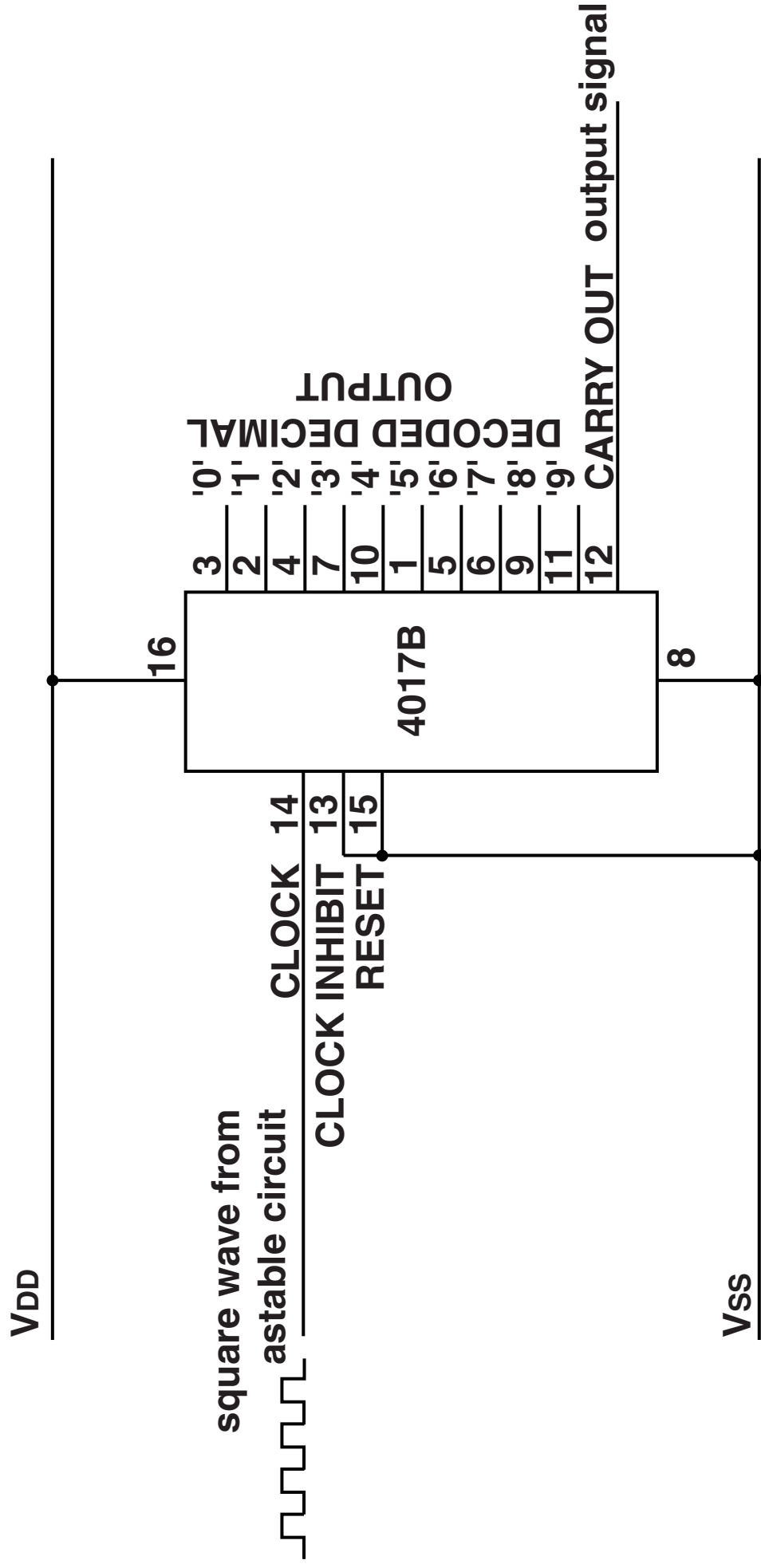


Fig. 7b



- (i) Complete Fig. 7b to show how the frequency of the output can be made adjustable. [2]
- (ii) In order to test the circuit output the signal is put through a decade counter. The circuit is shown in Fig. 8.

Fig. 8



Describe the effect that this process will have on the output signal.

[2]

(iii) Use sketches and notes to show ONE other way of testing the output.

[3]

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(c) The square wave output should only switch on when there is an animal nearby.

(i) Give the name of ONE sensor that could detect when an animal is nearby.

_____ [1]

(ii) Fig. 9 shows a truth table that can be used to decide when the output should be on.

A is the astable signal, B is the sensor signal and Q is the output.

From the list of logic ICs shown, select TWO logic ICs which could be used to match the truth table.

Fig. 9

A	B	Q
0	0	0
0	1	0
1	0	0
1	1	1

4071B quad 2 input OR gate

4011B quad 2 input NAND gate

4002B dual 4 input NOR gate

4081B quad 2 input AND gate

4070B quad 2 input XOR gate

1 _____

2 _____

[2]

- (iii) An incomplete printed circuit layout for the decade counter part of the circuit is shown in Fig. 10.

Add the following tracks to the layout:

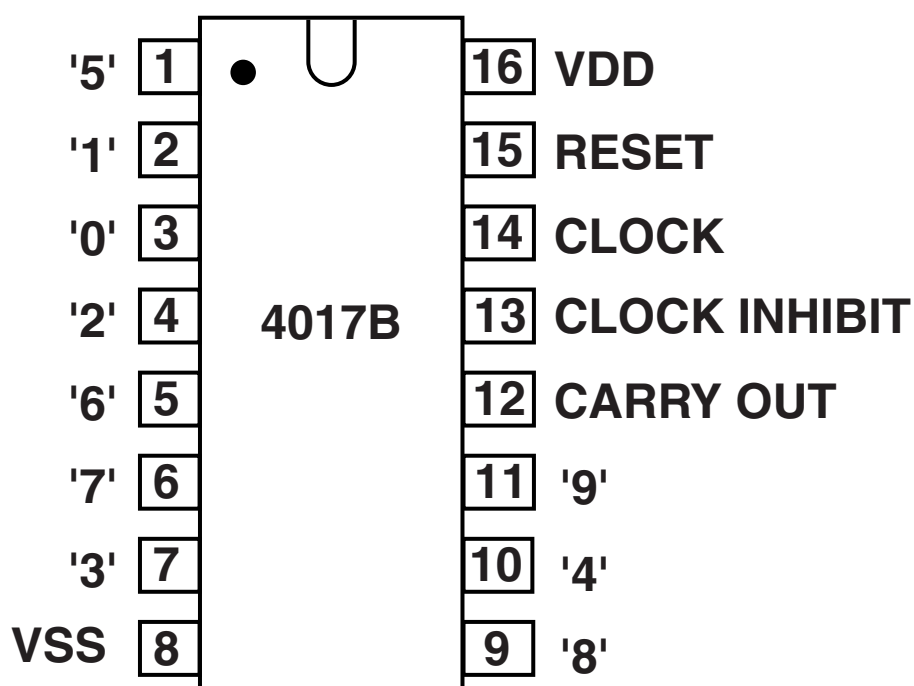
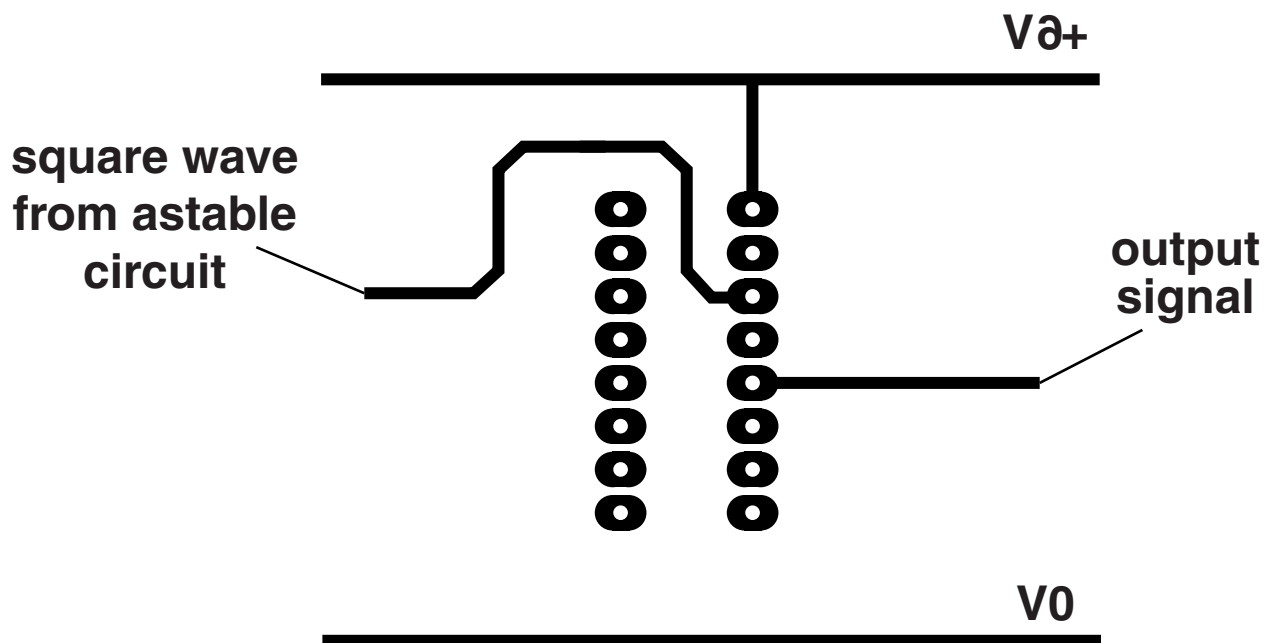
V_{SS} connection to 0V rail

clock inhibit to 0V rail

reset to 0V rail

[3]

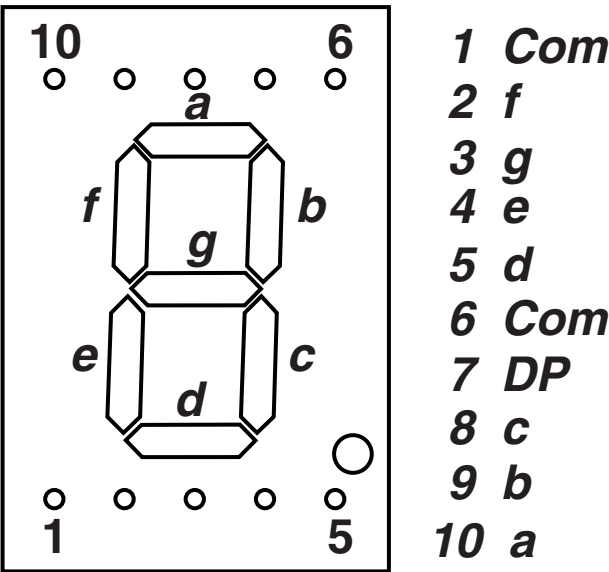
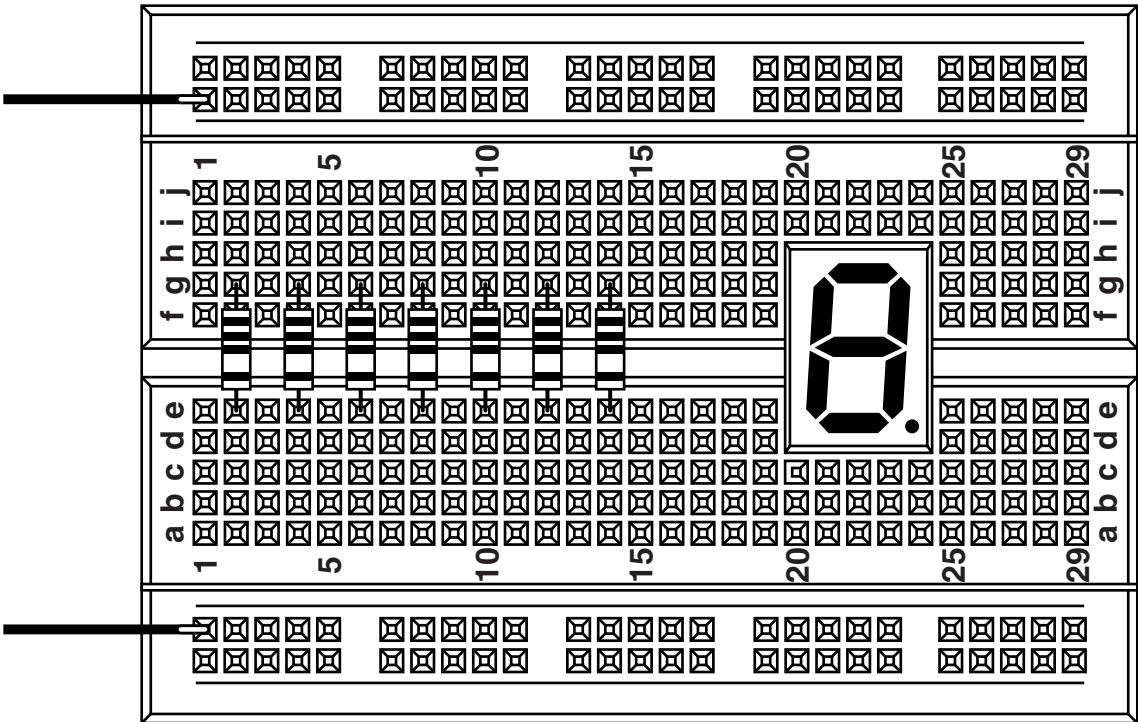
Fig. 10



[TOTAL: 15]

- 19 (a) Fig. 11 shows a simulation software breadboard with a common cathode seven segment LED display and current limiting resistors.
- (i) Using information from the pinout diagram add connections to allow the display to show '7'.

Fig. 11



[4]

- (ii) Simulated breadboards are often found on circuit designing software.
Give TWO advantages of using a simulated breadboard rather than a real one.

1 _____

2 _____

[2]

- (b) Each segment of the LED display should be limited to a current of 15 mA.
The supply voltage is +6V and the voltage drop on each segment is 1.95V.
Calculate the value of current limiting resistor that should be used for each segment.

Use the formula $V = I \times R$

_____ [3]

(c)* Self adhesive radio frequency identification devices (RFID) can be attached to the swimming hat of an open water or triathlon swimmer.

Discuss the use of RFID devices for collecting and storing data, compared to other methods. [6]

[illegible]

[TOTAL: 15]

END OF QUESTION PAPER



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