

Surname						Other Names					
Centre Number						Candidate Number					
Candidate Signature											

Leave blank

General Certificate of Secondary Education
June 2005

**DESIGN AND TECHNOLOGY
(ELECTRONIC PRODUCTS)
Foundation Tier**

3541/F

F



Thursday 16 June 2005 1.30 pm to 3.30 pm

<p>In addition to this paper you will require:</p> <ul style="list-style-type: none"> • blue or black pen, pencil, coloured pencils and ruler; • an Insert Sheet (enclosed). <p>You may use a calculator.</p>
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For Examiner's Use	
Number	Mark
1	
2	
3	
4	
5	
6	
7	
8	
TOTAL	
Examiner's initials	

Time allowed: 2 hours

Instructions

- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- Use the Insert Sheet included to help you answer Question 1.
- Do all rough work in this book. Cross through any work you do not want marked.

Information

- The maximum mark for this paper is 125.
- Mark allocations are shown in brackets.
- A list of formulae and other information is given on pages 2 and 3 which you may need to use when answering certain questions.
- Wherever calculations are needed you should show your working.
- You are reminded of the need for good English and clear presentation.

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

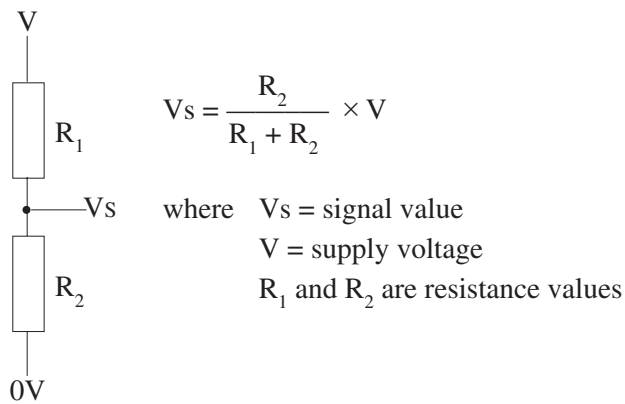
Potential Difference Potential Difference = Current \times Resistance ($V = I \times R$)

Series Resistors $R_{\text{total}} = R_1 + R_2 + R_3$ etc

Parallel Resistors $\frac{1}{R_{\text{total}}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

Electrical Power Electrical Power = Current \times Potential Difference ($P = I \times V$)

Potential Divider



Inverting Op-Amps Gain = $-\frac{R_f}{R_{in}}$ Where R_f = feedback resistor value
 R_{in} = input resistor value

Time Constant Time Constant \approx Resistance \times Capacitance ($T \approx R \times C$)

Astable
 Frequency for 555 $f = \frac{1.44}{(R_1 + 2R_2) \times C}$

Pulse duration $= \frac{1}{\text{frequency}}$

Time High $T_h = 0.693 \times (R_1 + R_2) \times C$

Time Low $T_l = 0.693 \times R_2 \times C$

Mark Space Ratio $= \frac{T_h}{T_l}$

You may need to use the following information when answering some of the questions.

The figures shown below and their decade multiples or submultiples are the series of preferred values in accordance with BS:2488.

E12 Resistor series: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82

E24 Resistor series 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82, 91

Capacitor series 10, 22, 47

Resistor Colour Code

Colour	Band 1	Band 2	Band 3 (No. of 0s)	Band 4 (Tolerance)
Black	0	0	None	
Brown	1	1	0	
Red	2	2	00	
Orange	3	3	000	
Yellow	4	4	0000	
Green	5	5	00000	
Blue	6	6	000000	
Violet	7	7	–	
Grey	8	8	–	
White	9	9	–	
				Gold = 5%
				Silver = 10%

TURN OVER FOR THE FIRST QUESTION

Turn over ►

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

1 **Figure 1** on the Insert Sheet shows eight different electronic components.

(a) Complete **Figure 2** below by both naming and drawing the electronic symbol for each component. Some parts have been completed as examples.





Component	Full Name	Symbol
A	
B	
C	
D	<i>Electrolytic Capacitor</i>	
E <i>Switch</i>	
F	
G	<i>Fuse</i>	
H	

Figure 2

(10 marks)

(b) Name a component that is described by each of the statements below.

(i) It has a resistance that changes as temperature changes.

.....
(1 mark)

(ii) It is used to limit the amount of current flow.

.....
(1 mark)

(iii) It will store a small charge of electricity.

.....
(1 mark)

(iv) It will light when current flows from the anode to cathode.

.....
(1 mark)

(v) It has a thin piece of wire which melts when overloaded.

.....
(1 mark)

(vi) It has three leads called anode, cathode and gate.

.....
(1 mark)

TURN OVER FOR THE NEXT QUESTION

Turn over ►

2 A resistance of 600R is needed in a circuit and as this value is not available, two resistors are to be used in series.

(a) Complete **Figure 3** by adding the values of the two resistors from the E12 series shown on page 3 to give the required 600R value. (2 marks)



Figure 3

(b) **Figure 4** shows two 100R resistors in parallel.

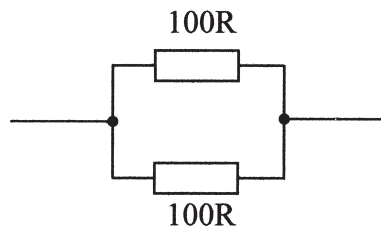


Figure 4

Calculate the resistance of this combination.

Formula

Working

Answer with units

(4 marks)

(c) Complete **Figure 5** to show the colour code of a 680R resistor with a $\pm 5\%$ tolerance.

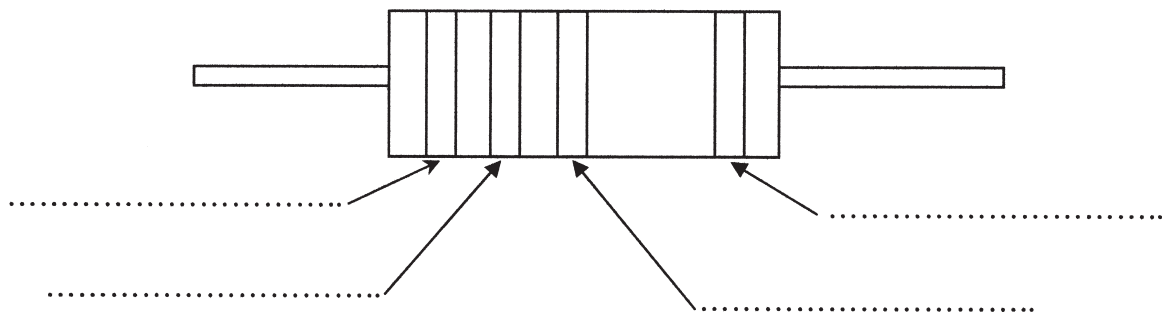


Figure 5

(4 marks)

3 Shown below are areas of electronic design where ICT could be used. Choose **three** areas from the list, stating when each could be used and explaining **one** advantage for each choice.

An example has been given.

Circuit simulation

PCB design

Case design

CAM

Example Spreadsheets

When used Calculating the cost of the components

Advantage As I changed the circuit design the total price of the
..... components automatically changed so I could keep control over my spending

1

When used (1 mark)

Advantage
..... (2 marks)

2

When used (1 mark)

Advantage
..... (2 marks)

3

When used (1 mark)

Advantage
..... (2 marks)

4 You have been asked to design an electronic dice to be used by children when playing games.

Analysis

- (a) List **two** things that you should think about when designing the electronic dice. An example has been given.

The likely cost of the whole project including both components and materials.

1

2

(4 marks)

Research

The layout of a research plan for the electronic dice is shown in **Figure 6**.

- (b) Complete **Figure 6** by adding suitable research sources and stating the information that you would hope to find. (7 marks)

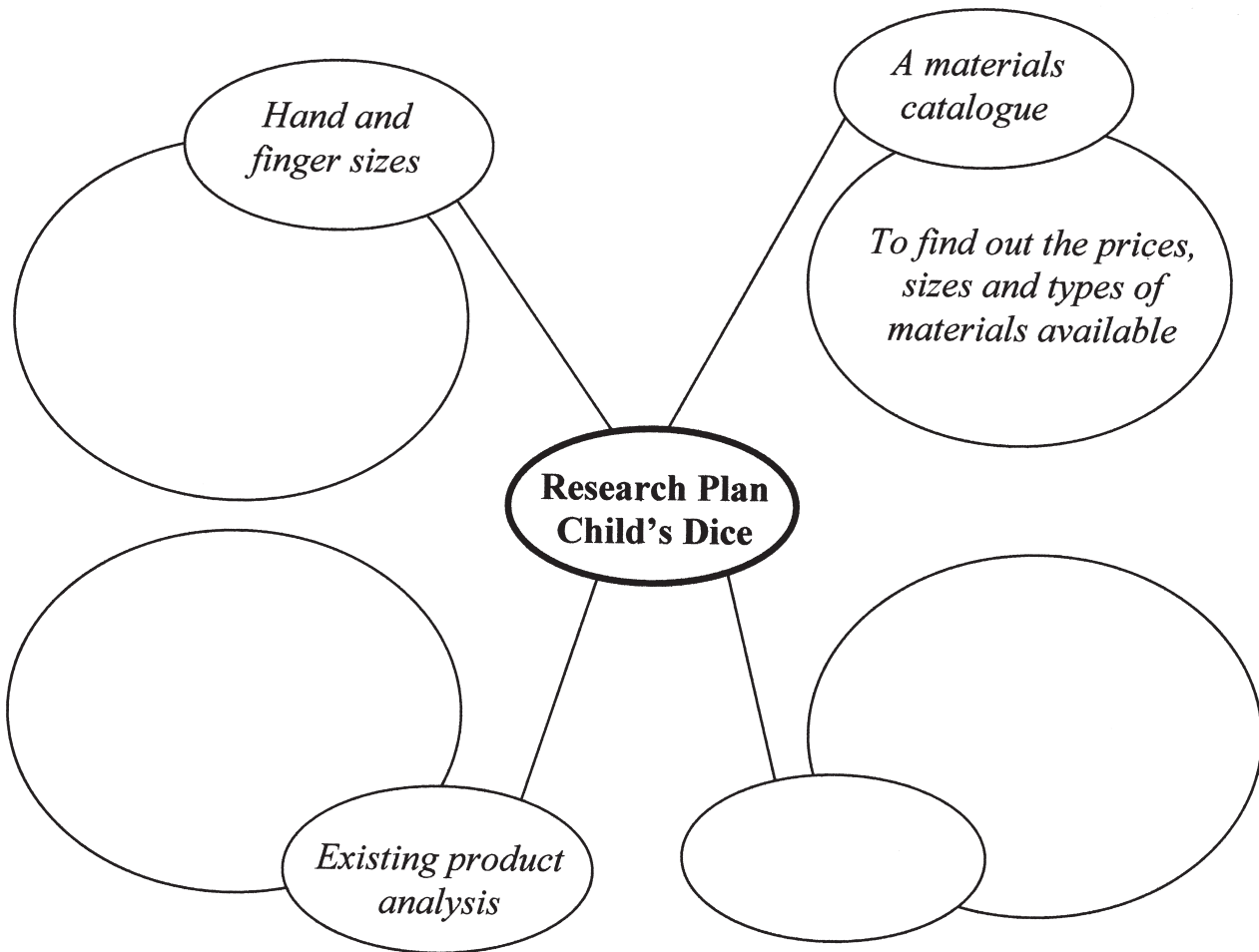


Figure 6

(c) Describe how the information from the analysis and research may affect the final design.

.....
.....
.....

(2 marks)

(d) Give **four** specification points for the electronic dice. **Two** of the points should be about the casing and **two** about the electronics. Examples have been given.

(i) Casing specifications

Not too heavy – so that it can be used by young children.

1

2

(4 marks)

(ii) Electronic specifications

The numbers will be made up from arrangements of 5 mm LEDs.

1

2

(4 marks)

TURN OVER FOR THE NEXT QUESTION

Turn over ►

5 This question is about designing, making and evaluating the electronic dice.

(a) (i) Use notes and sketches to show:

- a design for the casing of the dice; *(4 marks)*
- how the dice is switched on and activated. *(2 marks)*

Quality of communication *(2 marks)*

(ii) Give the name of a suitable material from which the casing could be made.

Material

(1 mark)

(iii) Use notes and sketches to show:

- a suitable method of fitting an LED into the case; *(2 marks)*
- how the circuit is securely held in place in the casing. *(3 marks)*

- (b) List **two** situations where health and safety hazards might be an issue whilst making the casing and give the precaution that you would need to take.

Situation 1

Precaution

.....

Situation 2

Precaution

.....

(4 marks)

- (c) Explain **two** methods of evaluating the finished dice.

1

.....

2

.....

(4 marks)

- (d) Give **two** reasons why quality checks need to be made during the making of electronic products.

1

.....

2

.....

(4 marks)

TURN OVER FOR THE NEXT QUESTION

Turn over ►

6 The automatic doors of a lift in a department store are controlled using logic gates.

(a) On **Figure 7** draw the missing symbol, name the **two** logic gates and complete the truth tables.

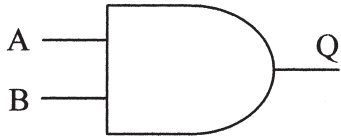
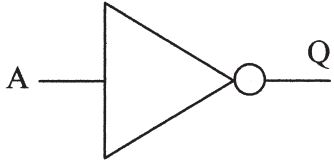
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Figure 7

(10 marks)

- (b) The lift will **only** operate if a person has requested the lift from another floor **or** a floor has been chosen by a person in the lift **and** the doorway is not obstructed.

Complete **Figure 8** using any of the logic gates shown in **Figure 7** so that the lift only operates when the conditions given above, are met. (6 marks)

Quality of drawing (2 marks)

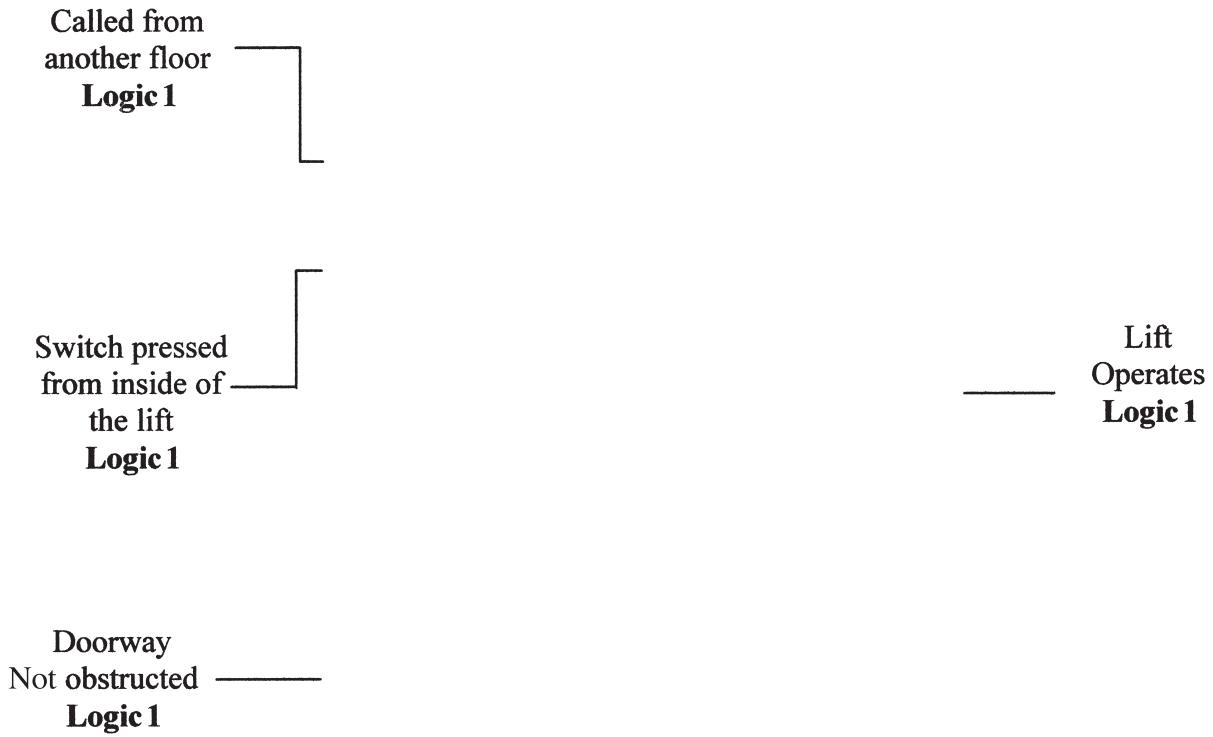


Figure 8

TURN OVER FOR THE NEXT QUESTION

Turn over ►

7 **Figure 9** shows a block diagram of a fire alarm.

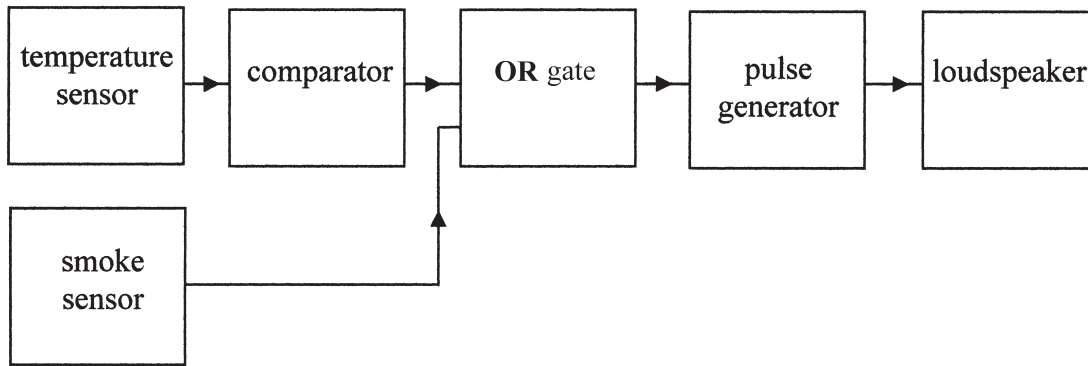


Figure 9

(a) State which block represents

(i) the final output stage (1 mark)

(ii) an input stage (1 mark)

(iii) an astable. (1 mark)

(b) State the block in which you would find

(i) an op-amp (1 mark)

(ii) a thermistor (1 mark)

(iii) the control of the frequency of the sound. (1 mark)

(c) **Figure 10** shows a pulse generator circuit used as part of the system.

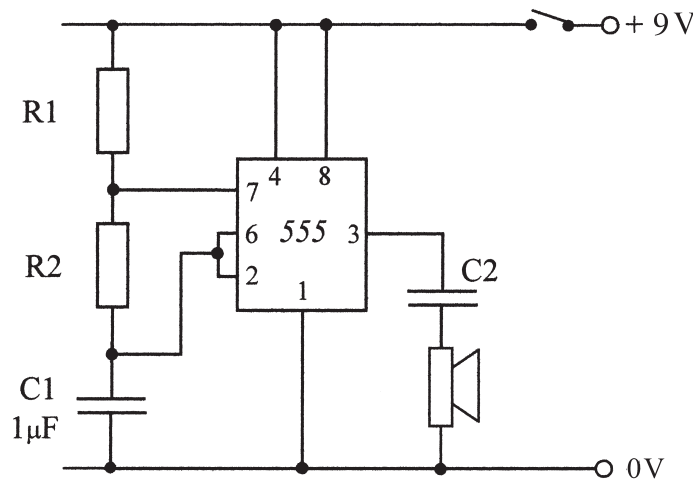


Figure 10

Component **C1** helps to control the frequency of the circuit.

(i) Circle the **two** components other than **C1** in **Figure 10**, that control the frequency of the circuit. (2 marks)

(ii) Explain the effect on the sound from the loudspeaker if the value of **C1** was increased.

.....

(2 marks)

(d) The final circuit could be constructed using either veroboard (stripboard) or on a PCB.

(i) Compare the use of veroboard as opposed to a PCB for producing the circuit.

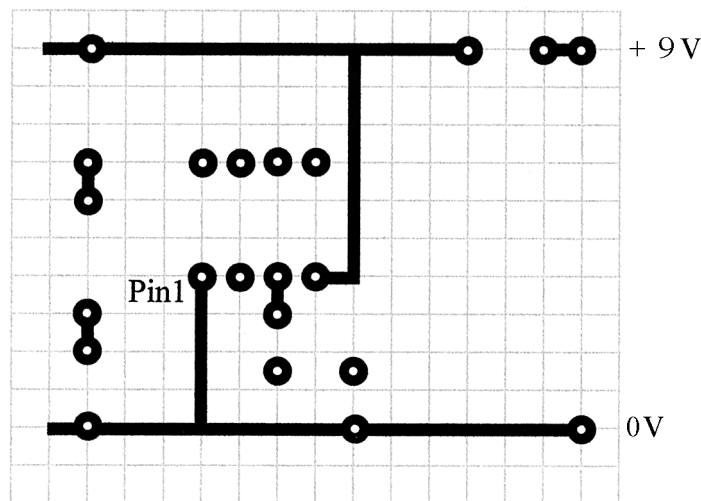
.....

(2 marks)

(ii) It is decided that the PCB method will be used.

Figure 11 shows the incomplete PCB design of the **pulse generator** stage of the circuit.

The pulse generator circuit is shown in **Figure 10**.



Viewed from the component side

Figure 11

Complete **Figure 11** by adding **five tracks** to the PCB so that:

- pin 8 is joined to the +V rail;
- pin 7 is joined between R1 and R2;
- pin 6 is joined to pin 2;
- pins 6 and 2 are joined between R2 and C1;
- C2 is joined to the loudspeaker.

(5 marks)
 Quality of drawing (2 marks)

Turn over ►

8 During the past twenty years the use of ICT and electronic control systems have revolutionised manufacturing.

Explain **one** advantage and **one** disadvantage that these developments have had for the environment.

Advantage

.....

.....

(3 marks)

Disadvantage

.....

.....

(3 marks)

END OF QUESTIONS

6

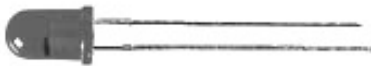
**DESIGN AND TECHNOLOGY:
ELECTRONIC PRODUCTS
FULL AND SHORT COURSE**

**3541F/3551F
F**

ASSESSMENT and
QUALIFICATIONS
ALLIANCE

The photographs on this sheet are for use in answering:

Foundation Tier: Question 1



A



B



C



D



E



F



G



H

Figure 1

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