Surname		Other Names	
Centre Number			Candidate Number				
Candidate Signature									

For Examiner's Use

General Certificate of Secondary Education
June 2007

DESIGN AND TECHNOLOGY (ELECTRONIC PRODUCTS)
Written Paper
Foundation Tier

3541/F

F

ASSESSMENT and QUALIFICATIONS ALLIANCE

Wednesday 13 June 2007 1.30 pm to 3.30 pm

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

You may use a calculator.

Time allowed: 2 hours

Instructions
- Use blue or black ink or ball-point pen. Use pencil only for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Answer the questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.
- Show the working of your calculations.

Information
- The maximum mark for this paper is 125.
- The marks for questions are shown in brackets.
- A list of formulae and other information, which you may wish to use in your answers, is provided on pages 2 and 3.
- You are reminded of the need for good English and clear presentation in your answers.

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

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

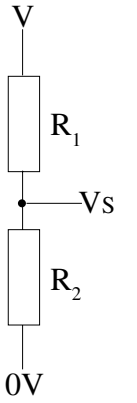
Potential Difference — Potential Difference = Current × Resistance — ($V = I \times R$)

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

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

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

Potential Divider



$Vs = \frac{R_2}{R_1 + R_2} \times V$

where Vs = signal value
V = supply voltage
R_1 and R_2 are resistance values

Inverting Op-Amps — $\text{Gain} = \frac{-Rf}{Rin}$ — Where Rf = feedback resistor value, Rin = input resistor value

Time Constant — Time Constant ≃ Resistance × Capacitance — ($T \simeq R \times C$)

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

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

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

Time Low — $Tl = 0.693 \times R_2 \times C$

Mark Space Ratio — $= \frac{Th}{Tl}$

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%

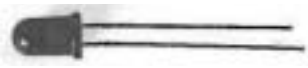
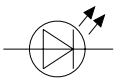
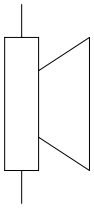
Turn over for the first question

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

This question is about component identification and function.

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

1 (a) Complete the table below by giving the names and symbols of the components shown in the photographs. The first one has been completed for you.

	Component	Name	Symbol
		LED	
(i)		Diode	
(ii)			
(iii)			
(iv)		Push to Make Switch	
(v)			
(vi)			
(vii)			
(viii)		LDR	

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www.rapidelectronics.co.uk

(12 × 1 mark)

(b) Certain types of electronic components must be put in the circuit the correct way round (polarised) whilst other types of electronic components do not (non-polarised).

In the table below, tick the correct box for **each** component. The first one has been done for you.

	Component	Polarised	Non-polarised
	Diode	✓	
(i)	Push to Make Switch		
(ii)	Fixed Resistor		
(iii)	Light Emitting Diode		
(iv)	Buzzer		
(v)	Electrolytic Capacitor		
(vi)	Thermistor		
(vii)	Transistor		

(7 × 1 mark)

19

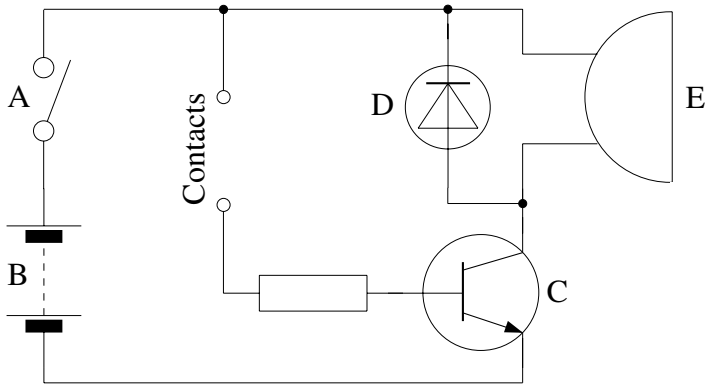
Turn over for the next question

This question is about circuit diagrams.

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

2 A student is developing an idea for a steady hand game and starts with the circuit shown in **Figure 1**.

Figure 1



(a) Identify which part of the system the components shown in the photographs are in, by using the word Input, Process or Output.

Component			
Input, Process or Output?			

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(3 marks)

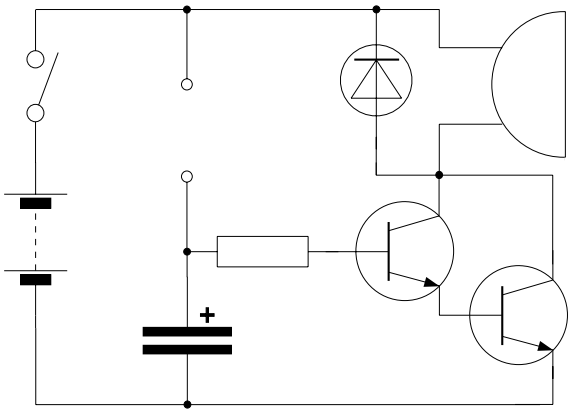
(b) Complete the table below to describe what the labelled components do in the circuit shown in **Figure 1**.

	Component	**What the component does in the circuit**
(i)	A	
(ii)	B	
(iii)	C	
(iv)	D	
(v)	E	

(5 × 1 mark)

(c) **Figure 2** shows a modified circuit with **two** changes.

Figure 2



Identify the changes made in **Figure 2** compared to **Figure 1** and state what effect **each** one has on how the circuit works.

Change 1 .....

Effect .....

.....

Change 2 .....

Effect .....

.....

(6 marks)

14

Turn over for the next question

This question is about research and analysis.

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

3 (a) Describe **two** methods a student could use to find information about existing electronic games.

Method 1.....

.....

.....

Method 2.....

.....

.....

(4 marks)

(b) In order to find out the features which might be wanted by people who play electronic games, a survey could be conducted.

Write **three** different questions a student could ask and give a reason for **each** to show how this will help with the design of the product.

An example is given.

Example:

Question – Should the game be portable?

Reason – This will affect the size, weight and possible power source.

Question 1.....

Reason .....

.....

Question 2.....

Reason .....

.....

Question 3.....

Reason .....

.....

(6 marks)

(c) From the survey it would appear most people would prefer to use a battery-powered game. Give **two** reasons why.

Reason 1 .....

.....

.....

Reason 2 .....

.....

.....

(4 marks)

(d) Why do some people prefer to use re-chargeable batteries?

.....

.....

.....

(2 marks)

(e) When batteries come to the end of their useful life they need to be disposed of.

(i) How can this be achieved safely?

.....

(1 mark)

(ii) Give **two** reasons why batteries should be disposed of carefully.

Reason 1 .....

.....

.....

Reason 2 .....

.....

.....

(4 marks)

21

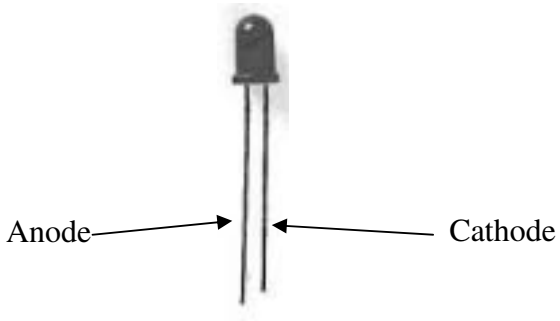
Turn over for the next question

This question is about LEDs and resistors.

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

4 (a) **Figure 3** shows an image of an LED, with the leads labelled.

Figure 3



(i) Which lead is usually connected to +V?

.....

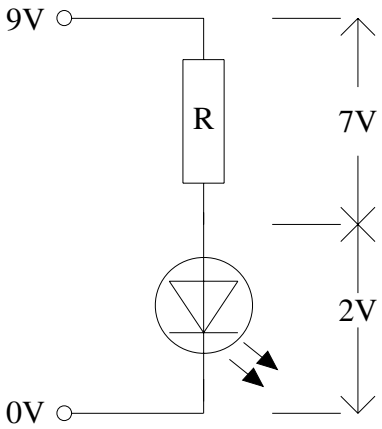
(1 mark)

(ii) On the case of the LED there is a *flat* which indicates the polarity.

Show on **Figure 3** where the flat would be found. *(1 mark)*

(b) The LED is connected in series with a fixed resistor as shown in **Figure 4**.

Figure 4



(i) Calculate the value of the resistor R, if the current through the LED is 20 mA.

Formula .....

Working

Answer with units .....

(4 marks)

(ii) Select from the list below a suitable resistor to use with the LED. Circle your answer.

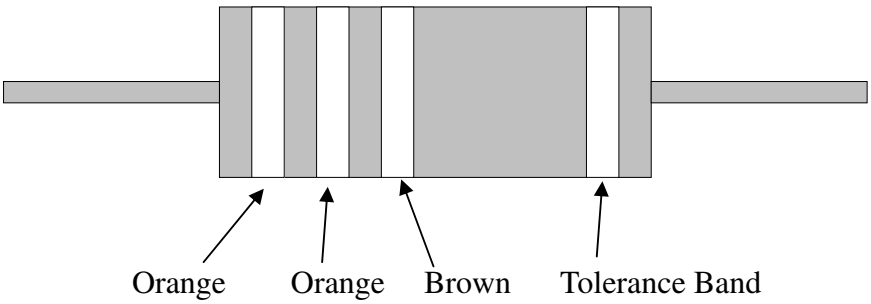
33R 330R 3K3 33K 330K 3M3

(1 mark)

(c) **Figure 5** shows the colour bands on a resistor.

Using the colour code on page 3 to help, state the value of this resistor.

Figure 5



Value of the resistor is .....

(3 marks)

10

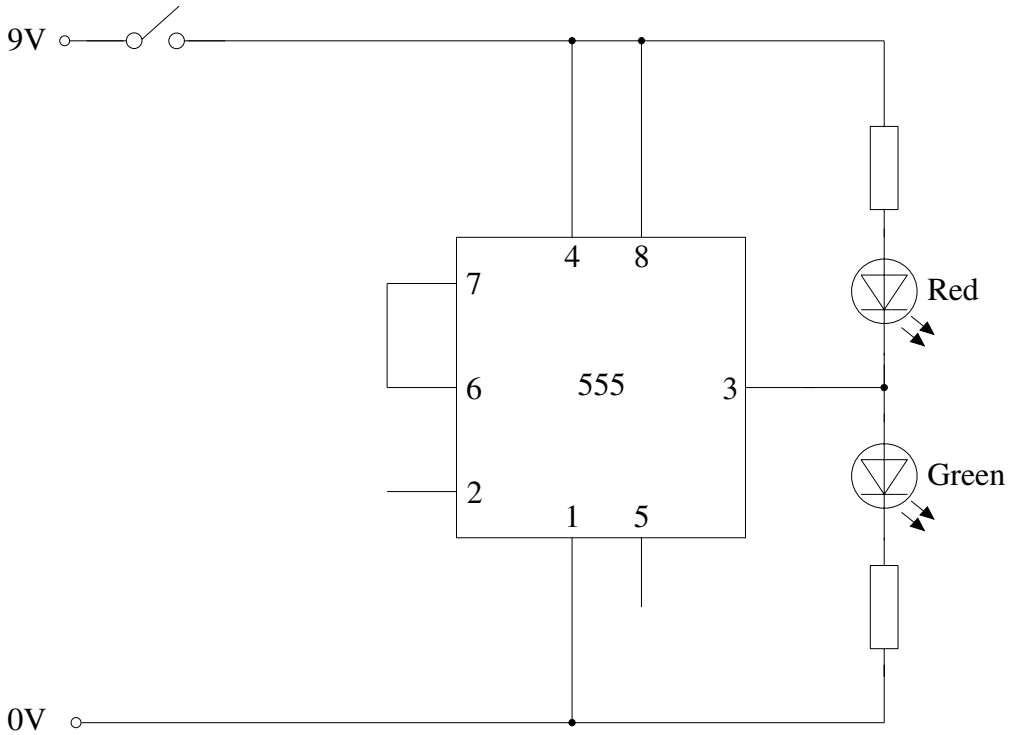
Turn over for the next question

This question is about monostable circuits.

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

5 **Figure 6** shows an incomplete circuit diagram for a monostable using a 555 Timer I C.

Figure 6



(a) Complete the circuit diagram for a monostable in **Figure 6** by

(i) adding a 100 K fixed resistor and a 22 μF capacitor to Pins 6 and 7 to give a time constant of approximately 2 seconds, *(3 marks)*

(ii) adding a fixed resistor and a suitable switch to Pin 2 so as to trigger the 555 Timer I C when the switch is pressed. Clearly label the resistor to show its value.
(4 marks)

Quality of drawing (2 marks)

(b) Describe what happens to the LEDs when the circuit is switched on and then triggered.

(i) circuit switched on

.....

.....

.....

(2 marks)

(ii) circuit triggered

.....

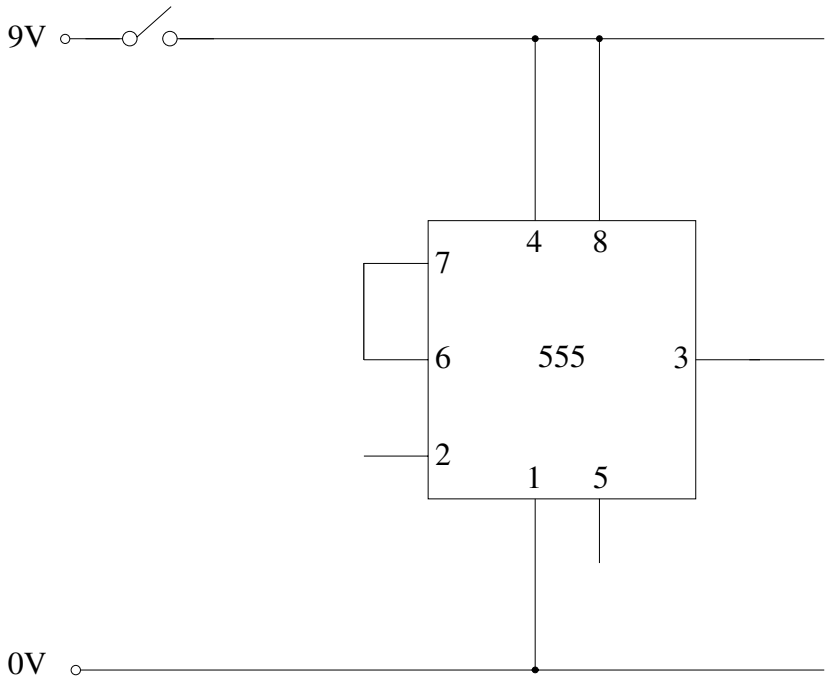
.....

.....

(2 marks)

(c) Connect a buzzer to the output, Pin 3, of the 555 Timer I C shown in **Figure 7**, so that the buzzer will sound when the output goes high.

Figure 7



(2 marks)

15

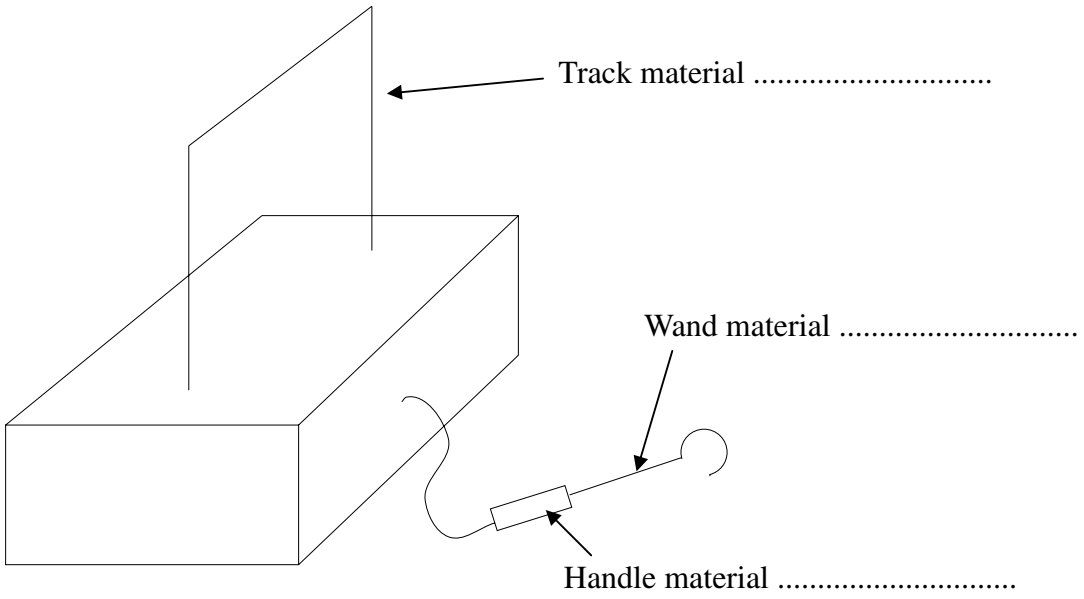
This question is about designing the case for a product.

You are advised to spend about 30 minutes on this question.

6 A simple case design for a steady hand game is shown in **Figure 8**. This could house a similar circuit to the one developed in **Question 5**.

(a) On **Figure 8** label suitable materials for the track, wand and handle.

Figure 8



(3 marks)

(b) Suggest **three** improvements to the design in **Figure 8** above.

1 .....

2 .....

3 .....

(3 marks)

(c) Using sketches and notes, show how you would improve the design of the steady hand game using the following specification points.

(i) a suitable specific material for the case *(2 marks)*

(ii) your suggested improvements from part (b) *(6 marks)*

(iii) the position of the **two** LEDs *(1 mark)*

(iv) sound holes for a buzzer *(1 mark)*

(v) a suitable on/off switch *(2 marks)*

Quality of communication (3 marks)

Chosen specific material .....

Use the space below to complete your answer.

(d) Evaluate your case design for its suitability for commercial production in batches of 100. Give reasons for any changes you suggest.

.....

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(6 marks)

27

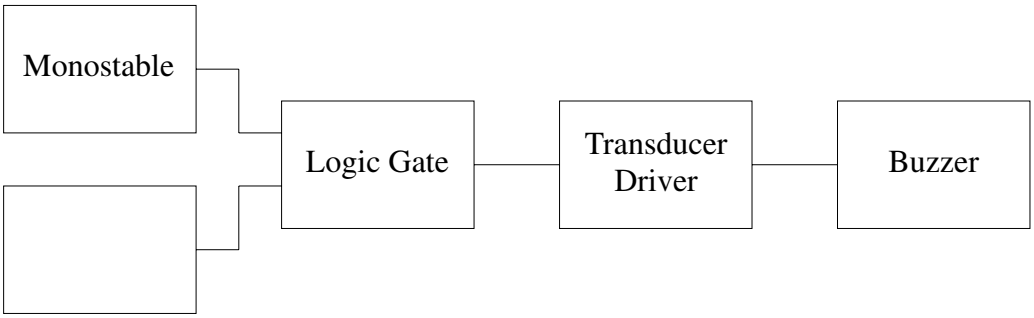
This question is about the systems approach and logic gates.

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

7 A student wants the buzzer in a steady hand game to pulse on and off for a set time rather than just staying on.

(a) Complete the system diagram in **Figure 9** to make this happen.

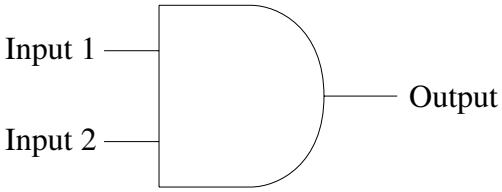
Figure 9



(1 mark)

(b) **Figure 10** shows the logic gate used.

Figure 10



(i) What is the name of this logic gate? .....

(1 mark)

(ii) Complete the truth table to show the state of the output.

Input 1	Input 2	Output
0	0	
0	1	
1	0	
1	1	

(4 marks)

6

This question is about the social, moral and environmental aspects of electronic games.

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

8 Electronic games have changed the way we spend our leisure time.

(a) Describe how electronic games have changed in recent years.

.....

.....

.....

.....

(3 marks)

(b) Explain the impact electronic games are said to have had on personal health and on social and family life.

(i) Personal health .....

.....

.....

.....

(2 marks)

(ii) Social and family life .....

.....

.....

.....

(2 marks)

(c) The rapid rate of change of electronic products means that some products soon become obsolete.

(i) What advantages does this have for the manufacturer?

.....

.....

.....

(3 marks)

(ii) What disadvantages does this have for the manufacturer?

.....

.....

.....

(3 marks)

13

END OF QUESTIONS

There are no questions printed on this page