Surname		Other Names	
Centre Number			Candidate Number								
Candidate Signature											

For Examiner's Use

General Certificate of Secondary Education
June 2006

DESIGN AND TECHNOLOGY (ELECTRONIC PRODUCTS)
Written Paper
Foundation Tier

3541/F

F

Wednesday 14 June 2006 1.30 pm to 3.30 pm

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

You may use a calculator.

Time allowed: 2 hours

Instructions
- Use blue or black ink or ball-point pen. Use pencil and coloured pencils 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			
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.

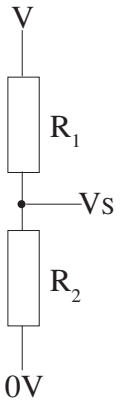
Potential Difference — Potential Difference = Current × Resistance (V = I × R)

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 × 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 — $Gain = \frac{-Rf}{Rin}$ Where Rf = feedback resistor value, Rin = input resistor value

Time Constant — Time Constant ≃ Resistance × Capacitance (T ≃ R × 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

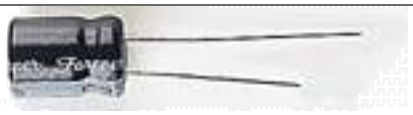
Colour	Band 1	Band 2	Band 3 (No. of 0s)	Band 4 (Tolerance)
Black	0	0	None	
Brown	1	1	0	
Red	2	2	00	
Orange	3	3	000	
Yellow	4	4	0000	
Green	5	5	00000	
Blue	6	6	000000	
Violet	7	7	–	
Grey	8	8	–	
White	9	9	–	
				Gold = 5%
				Silver = 10%

Turn over for the first question

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

1 This question is about identifying components.

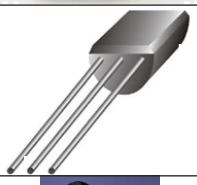
(a) Name the following components.

	Component	Component Name
e.g.		Light Emitting Diode
A		
B		
C		
D		
E		
F		
G		
H		
I		

(9 marks)

(b) In the systems approach, there are three stages to a circuit: **Input, Process and Output**.

Complete the table below by placing a tick in the appropriate column to show in which stage of the circuit each component is usually found.

	Component	Input	Process	Output
e.g.				✓
A				
B				
C				
D				
E				
F				
G				
H				
I				

(9 marks)

18

2 This question is about designing a circuit.

An advertising company has asked you to design a small electronic torch as a promotional gift.

(a) List **three** things which you need to consider before you begin to design the product. Give an explanation or reason for each. An example has been given to help you.

For example: The price must not exceed £2 otherwise it will be too expensive.

1 .....

.....

2 .....

.....

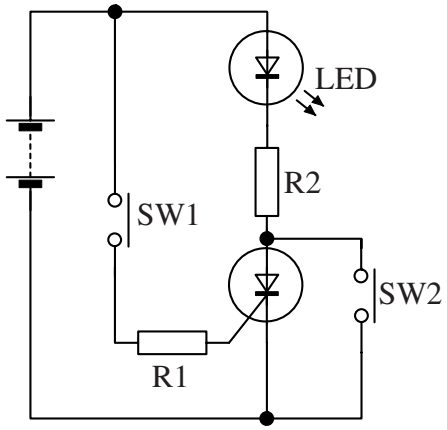
3 .....

.....

(6 marks)

(b) A circuit for the torch using a Thyristor and an LED is shown in **Figure 1**.

Figure 1



Explain what happens when the following actions are carried out in the order shown.

(i) SW1 is pressed and released.

.....

.....

.....

.....

(2 marks)

(ii) SW2 is pressed and released.

.....

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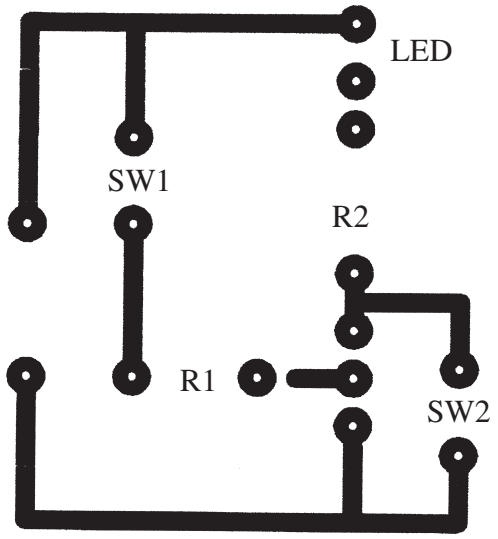
.....

.....

(2 marks)

(c) The PCB layout of the circuit in **Figure 1** is shown in **Figure 2**. It was produced using Computer Aided Design.

Figure 2



(i) When the circuit was built, it did not work.

On **Figure 2**, identify **two** mistakes which could be the cause of the problem by drawing a circle round each mistake.

(2 marks)

(ii) Describe the advantages of using Computer Aided Design for producing PCB layouts.

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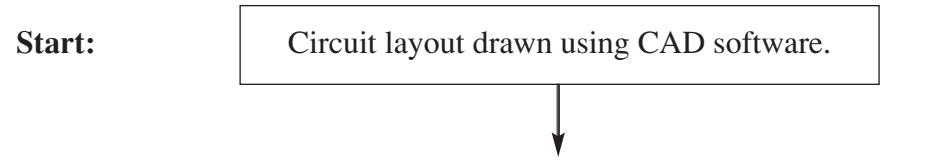
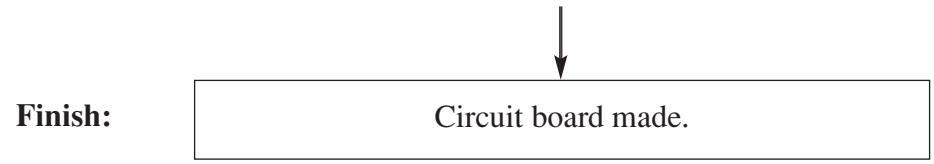
(4 marks)

16

3 This question is about producing a circuit on PCB.

(a) Using a production method you are familiar with, set out the stages needed when making a circuit board, prior to drilling and adding the components.





(10 marks)

(b) Health and Safety is important when making the PCB, drilling the holes and soldering the components in place.

Identify **two** different hazards and the precautions which need to be taken.

(i) Hazard 1: .....

Precaution: .....

.....

(2 marks)

(ii) Hazard 2: .....

Precaution: .....

.....

(2 marks)

(c) Identify **two** Quality Control checks you could make to the finished circuit after the components are soldered in place.

1 .....

.....

2 .....

.....

(2 marks)

(d) When the circuit was first tested it failed to work.

Describe how you would have checked that the circuit was receiving power from the battery.

.....

.....

.....

.....

(2 marks)

18

4 This question is about designing the case for a product.

A student is designing a rear warning light for a bicycle.
The case for the light is to be made by vacuum forming.

(a) (i) Name a suitable material that could be used to make the case.

.....

(2 marks)

(ii) Explain, using notes and sketches, the stages in the vacuum forming process when making the case.

(5 marks)

(b) The warning light is battery powered, has an On/Off switch and four LEDs. Using notes and sketches, develop a design for the case which shows the following features:

- the position of the four LEDs;
- a way of holding the LEDs in the case;
- the position of the On/Off switch;
- how the battery can be easily changed.

(9 marks)

Quality of communication *(3 marks)*

(c) Use notes and sketches to show a method of attaching the case to the bicycle.

(6 marks)

Quality of communication *(2 marks)*

27

5 This question is about microcontrollers.

The student developing the warning light from **Question 4** wants the LEDs to flash on and off and is considering using a PIC.

(a) Compare the use of a PIC with a 555 Timer IC to control the LEDs.

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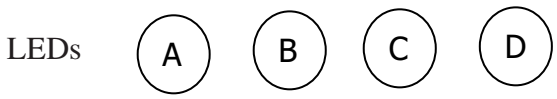
(4 marks)

(b) Using a programming system you are familiar with, produce a sequence of commands which would make a set of 4 LEDs, shown in **Figure 3**, switch on as shown below. Next to each of the commands, explain its purpose.

Figure 3



- All four LEDs switch on for 2 seconds.
- A, B, C and D switch on in sequence, each for 1 second.
- All four LEDs switch on for 2 seconds.
- All four LEDs switch off for 0.5 seconds.
- This repeats continuously.

Produce your programme on page 13.

Command	Explanation
A B C D	.....
	.....
	.....
A B C D	.....
	.....
A B C D	.....
	.....
	.....
A B C D	.....
	.....
A B C D	.....
	.....
	.....
A B C D	.....
	.....
A B C D	.....
	.....
	.....
	.....

(14 marks)

18

6 This question is about a monostable circuit.

A student is designing a small light for emergencies and has decided to include a feature which would automatically switch off the light after an amount of time.

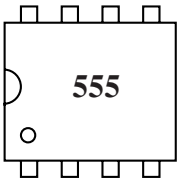
A 555 IC, operating as a monostable, can provide the time delay.

(a) The 555 IC is in an 8 pin package.

On the plan view in **Figure 4**:

- clearly label Pin 2 with a **2**
- clearly label Pin 7 with a **7**

Figure 4



(2 marks)

(b) **Figure 5** (on page 15) shows an incomplete circuit diagram for the monostable circuit.

Complete **Figure 5** by adding the following components:

(i) a fixed resistor and polarised capacitor to Pins 6 and 7 to create a timing potential divider; *(3 marks)*

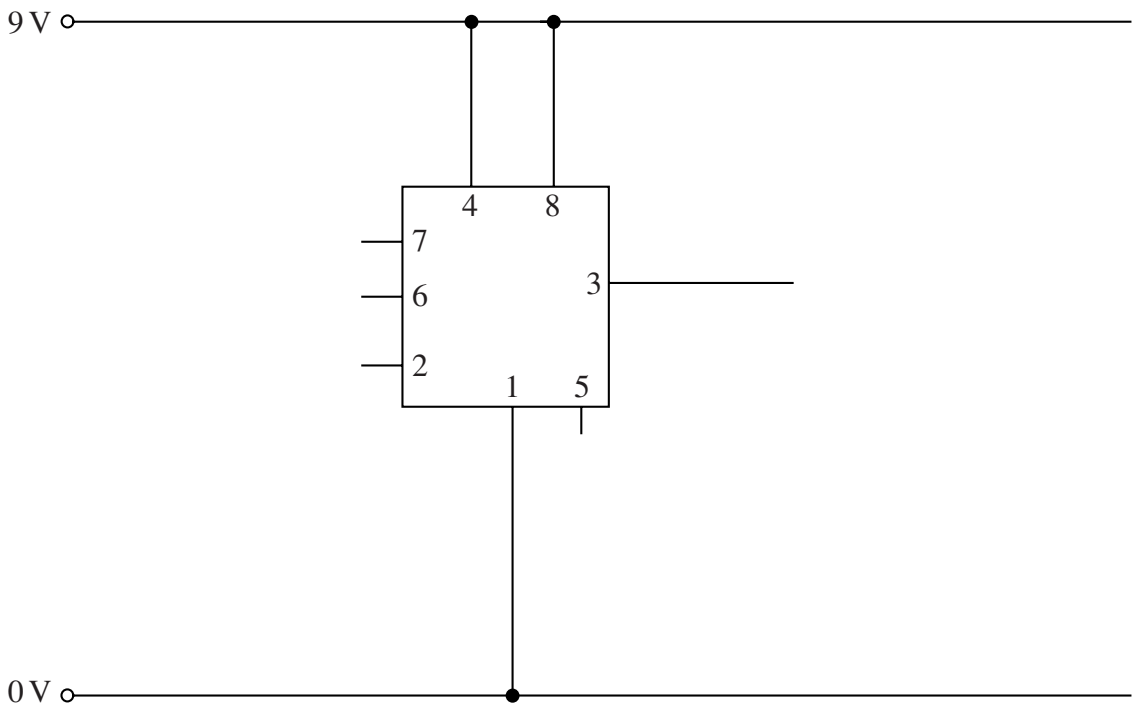
(ii) a 10 K fixed resistor between Pin 2 and 9 V; *(2 marks)*

(iii) a push to make switch between Pin 2 and 0 V; *(2 marks)*

(iv) a fixed resistor, a suitable transducer driver and a lamp to the output, Pin 3, so that it will light when Pin 3 goes high. *(3 marks)*

Quality of drawing *(2 marks)*

Figure 5



(c) Explain why the lamp should **not** be connected directly to the output of the 555 IC.

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.....

(2 marks)

(d) Calculate the time constant for the monostable if the resistor is 470 K and the capacitor is 100 µF.

Formula: .....

Working:

Answer with units: .....

(4 marks)

20

Turn over for the next question

7 This question is about the development of electronic products.

The development of electronic products is having a major impact on society, an example being personal music systems.

'Sony' is a registered trademark of Sony Corporation, Japan.

(a) Describe the advantages **and** disadvantages the development of electronic products has had for teenagers.

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(4 marks)

(b) Most of these electronic products use batteries. Why is it important to dispose of batteries correctly to protect the environment?

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(4 marks)

END OF QUESTIONS