

Surname						Other Names					
Centre Number						Candidate Number					
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General Certificate of Secondary Education  
 Summer 2003  
 Foundation Tier

**DESIGN AND TECHNOLOGY  
 (ELECTRONIC PRODUCTS) (SHORT COURSE)**

**3551/F**

**F**



Monday 23 June 2003 1.30 pm to 3.00 pm

**In addition to this paper you will require:**

- blue or black pen, pencil, coloured pencils and ruler.

You may use a calculator.

For Examiner's Use	
Number	Mark
1	
2	
3	
4	
5	
<b>TOTAL</b>	
Examiner's initials	

Time allowed: 1 hour 30 minutes

**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.
- Do all rough work in this book. Cross through any work you do not want marked.

**Information**

- The maximum mark for this paper is 100.
- Mark allocations are shown in brackets.
- A list of formulae and other information is given on pages 3 and 4 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.

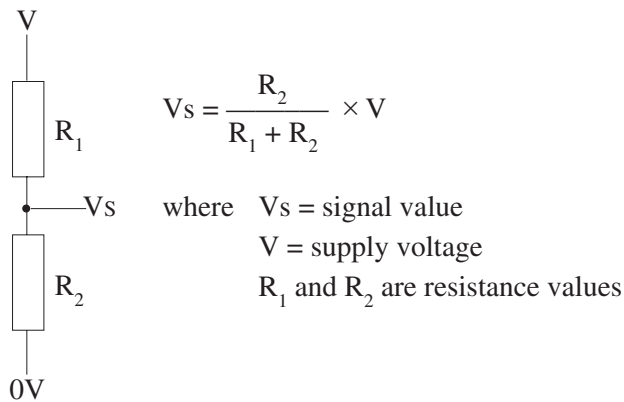
You may need to use one or more of the following formulae when answering questions which include calculations.

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

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

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

Potential Divider



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       $= \frac{1}{\text{frequency}}$

Turn over ►

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

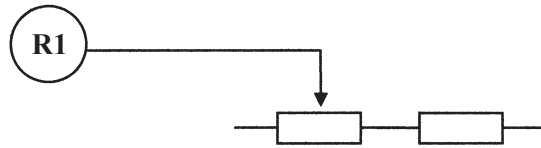
Capacitor series          10, 22, 47

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%

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

1 **Figure 1** shows two resistors.



**Figure 1**

(a) Circle **one** of the words below which best describes the resistor combination shown in **Figure 1**.

**Parallel**

**Series**

*(1 mark)*

(b) R1 has four colour bands – Brown Black Red Gold.

(i) State the value of R1.

.....  
*(3 marks)*

(ii) The total resistance of the combination shown is 2K.  
Calculate the value of the second resistor.

Formula .....

Working

Answer and units .....  
*(4 marks)*

(c) The gold band indicates the level of “tolerance” of the resistor value. Explain the meaning of “tolerance”.

.....  
.....  
.....  
*(2 marks)*

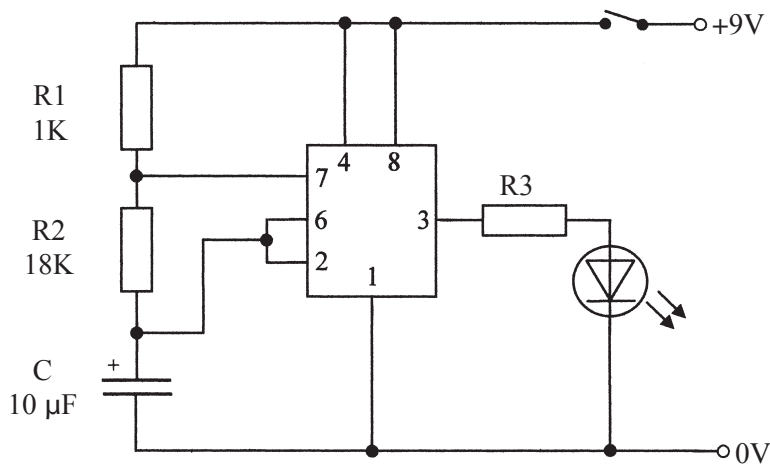
2 A student has been investigating the design for a circuit to be used in a garden shed as a dummy alarm.

(a) Explain **two** advantages of using computer simulation software to develop and test circuit designs.

- 1 .....
- .....
- 2 .....
- .....

(2 marks)

(b) **Figure 2** shows a pulse generator controlling the flash rate of an LED.



**Figure 2**

Circle **one** of the words below which best describes the circuit shown in **Figure 2**.

- Astable**
- Monostable**

(1 mark)

(c) R1 and R2 help to control the frequency of the circuit.  
Name the other component that controls the frequency of the circuit.

.....  
(1 mark)

(d) (i) Explain the reason for including R3 in the circuit.

.....  
.....

(2 marks)

(ii) Calculate the value of R3 when the output from pin 3 is 7V, the LED uses 2V and draws a current of 20mA.

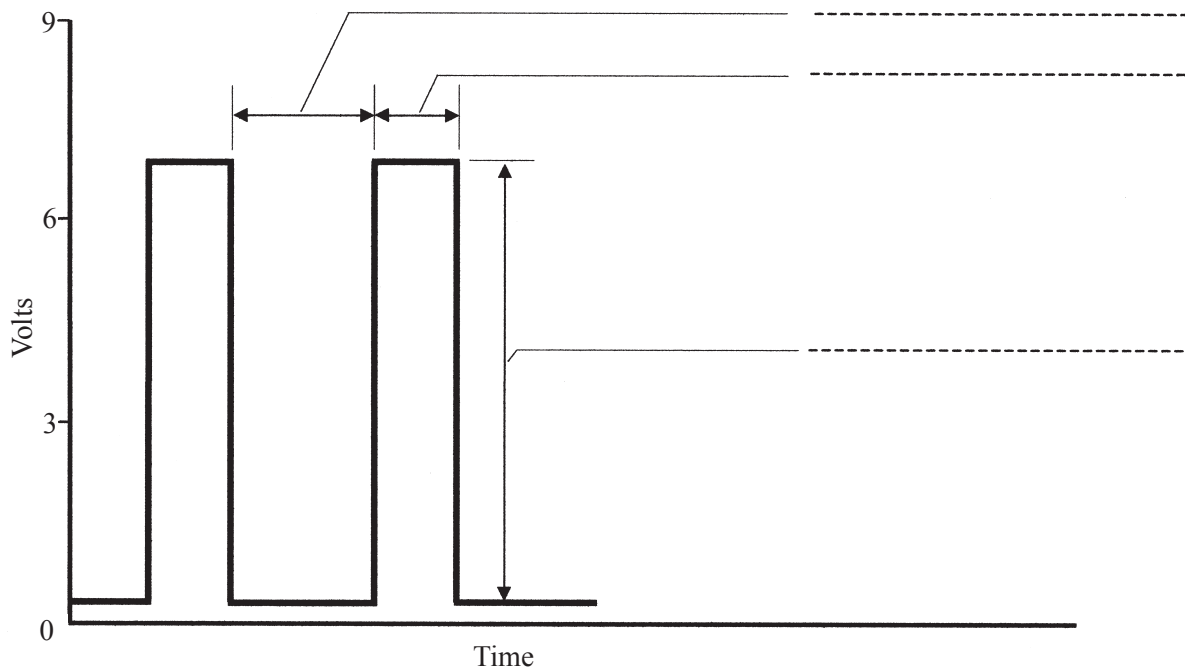
Formula .....

Working

Answer and units .....

(4 marks)

(e) **Figure 3** shows the output waveform from the pulse generator.



**Figure 3**

Complete **Figure 3** by labelling the:

- mark
- space
- amplitude

(3 marks)

**QUESTION 2 CONTINUES ON THE NEXT PAGE**

**Turn over ►**

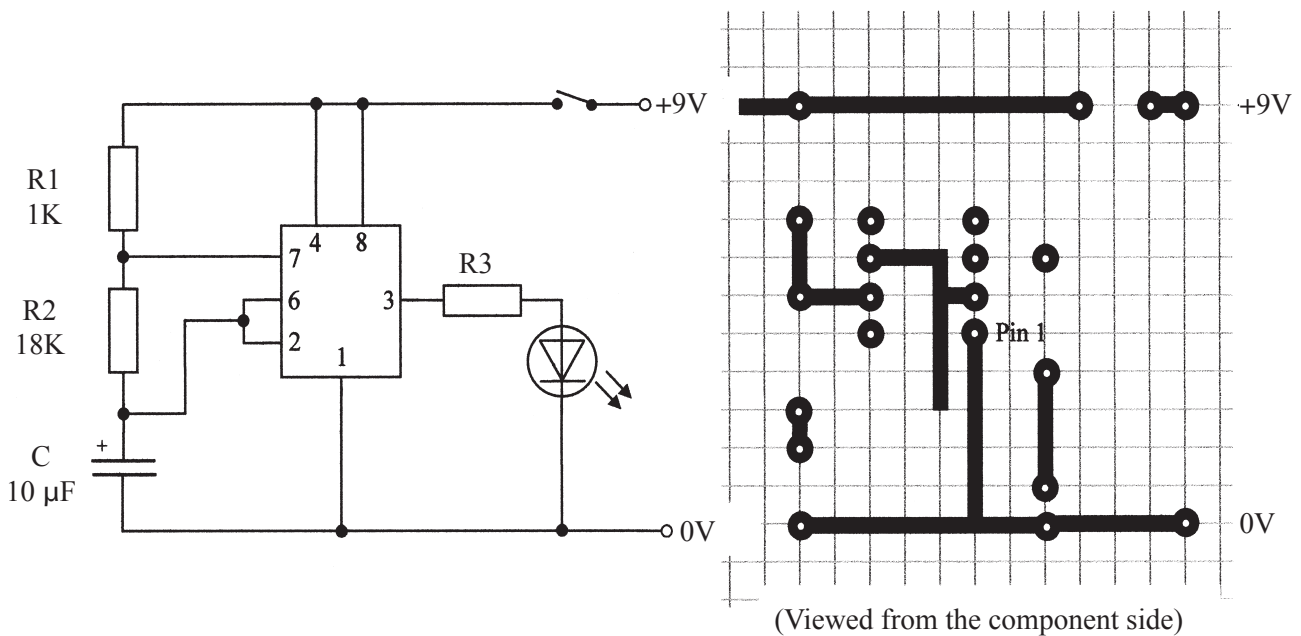
(f) The PCB of the chosen circuit was designed using Computer aided Design (CAD) software.

Give **two** advantages of using CAD to design the PCB.

- 1 .....
- .....
- 2 .....
- .....

(2 marks)

(g) **Figure 4** shows the pulse generator circuit and the incomplete PCB design.



**Figure 4**

Complete **Figure 4** by adding **four** tracks to the PCB so that:

- (i) pin 4 is connected to the +9V rail; (1 mark)
- (ii) the output from the IC is through the resistor and the LED to 0V; (1 mark)
- (iii) the IC is connected to the junction of C and R2; (1 mark)
- (iv) the +9V supply is connected to the IC. (1 mark)

(h) The shell of the alarm case is to be vacuum formed.

(i) Name a specific plastic material that could be used to vacuum form the case.

.....  
(1 mark)

(ii) When planning the making of the mould important features need to be considered.

Complete **Figure 5** by explaining the reason for including the features given.

Feature	Explanation
<i>Smooth surfaces.</i>	
<i>Rounded corners and edges.</i>	
<i>The sides of the mould are cut at an angle and slope inwards.</i>	
<i>Small holes drilled around the edge of the main shape.</i>	<i>To make sure that the plastic will be pulled close to the mould and any details or features will be clearly formed.</i>

**Figure 5**

(6 marks)



3 A student has been looking at possible systems and circuits for an automatic bath water temperature control.

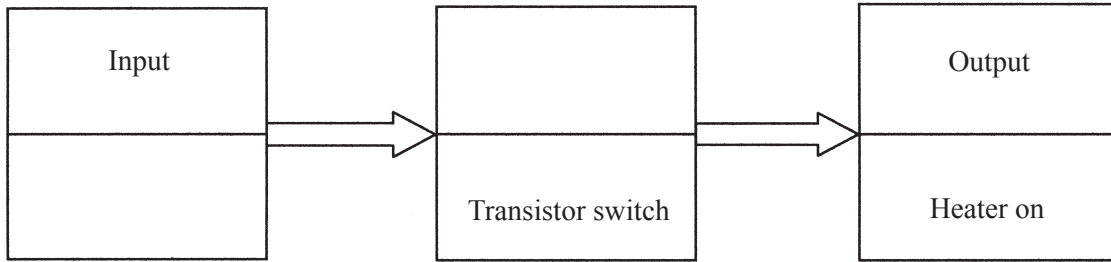


Figure 6

- (a) (i) Complete **Figure 6** for a heating control system. (2 marks)  
 (ii) Name the type of control system shown.

.....  
(1 mark)

(b) Some testing was carried out using the circuit shown in **Figure 7**.

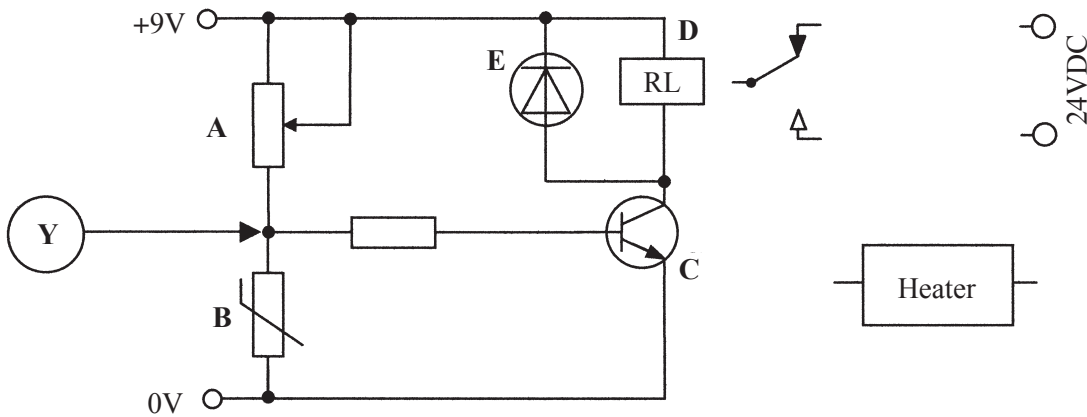


Figure 7

Name the components in the diagram above which are labelled:

- (i) **A** ..... (1 mark)  
 (ii) **B** ..... (1 mark)  
 (iii) **C** ..... (1 mark)  
 (iv) **D** ..... (1 mark)  
 (v) **E** ..... (1 mark)

(c) With reference to **Figure 7**.

(i) State which **two** components make up the potential divider part of the circuit.

..... and .....  
(2 marks)

(ii) State what happens to the resistance of component **B** when it gets warm.

.....  
(1 mark)

(iii) State the reason for including component **A** in the circuit.

.....  
(2 marks)

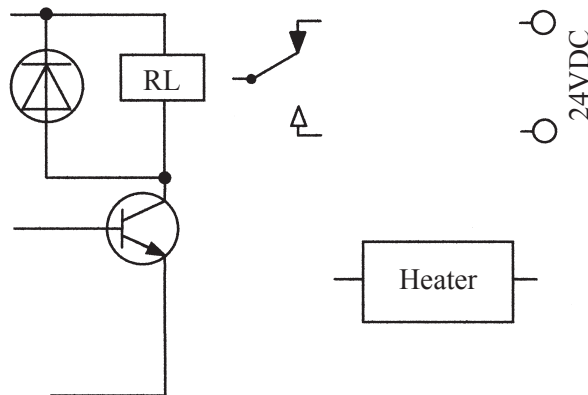
(iv) State what happens to the voltage at **Y** when it gets warm.

.....  
(1 mark)

(v) Give the voltage required at the base of a transistor in order to “switch” it on.

.....  
(1 mark)

(d) Show, by completing **Figure 8**, how the heater, the 24VDC power supply and the relay would be connected so that the heater is switched on when the relay is energised.



**Figure 8**

(3 marks)

QUESTION 3 CONTINUES ON THE NEXT PAGE

Turn over ►

(e) When designing electronic circuits or systems you might consider using a Peripheral Interface Controller (PIC).

(i) Give **two** advantages of using a PIC in place of a control system made up of individual components.

1 .....

2 .....

(2 marks)

(ii) A list of the operations when using a PIC is shown below, they are not in the correct order.

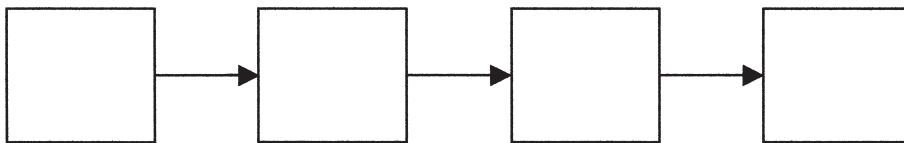
**A** – Download onto PIC.

**B** – Insert chip into final working circuit/output module.

**C** – Design flow chart/procedure/program using a PC.

**D** – Test the procedure on screen.

Complete the block diagram shown as **Figure 9**, using the letters **A**, **B**, **C** and **D** to give the correct order of operations when using PIC microprocessors.



**Figure 9**

(3 marks)

- 4 A student has decided to design and make an educational toy that will help to encourage young children to improve their maths.

Figure 10 shows the basic outline for the toy.

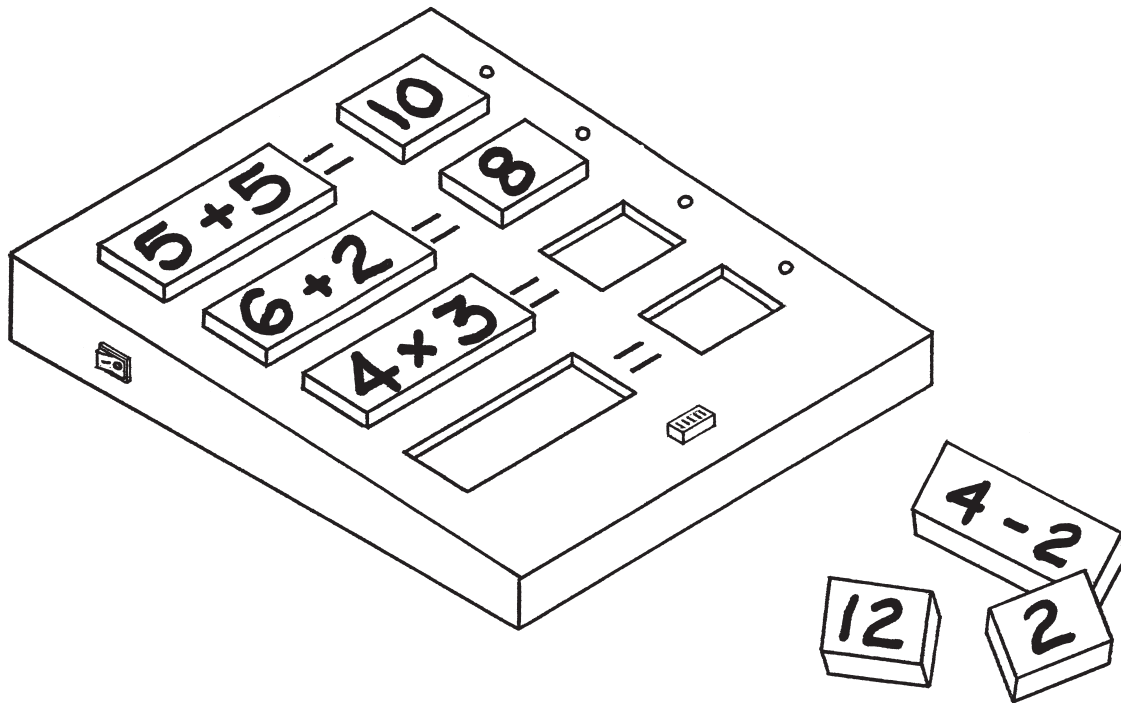


Figure 10

Various question blocks can be placed in the spaces on the left, the child then needs to place the correct answer blocks in the spaces on the right.

- (a) List **three** more important design considerations that you should consider when designing for young children.

1 *Must be colourful – so it is attractive for children to use.*

2 .....

3 .....

4 .....

(6 marks)

- (b) List **three** more useful areas for research when designing children’s toys.

1 *Different materials – to find out prices, availability and properties.*

2 .....

3 .....

4 .....

(6 marks)

- (c) (i) Give the name of a specific material from which the case could be made and explain the reason for your choice.

Material .....  
*(1 mark)*

Reason .....  
.....  
*(2 marks)*

- (ii) Use notes and drawings to show clearly how the casing would be constructed.  
Quality of solution *(5 marks)*  
Quality of drawing *(2 marks)*

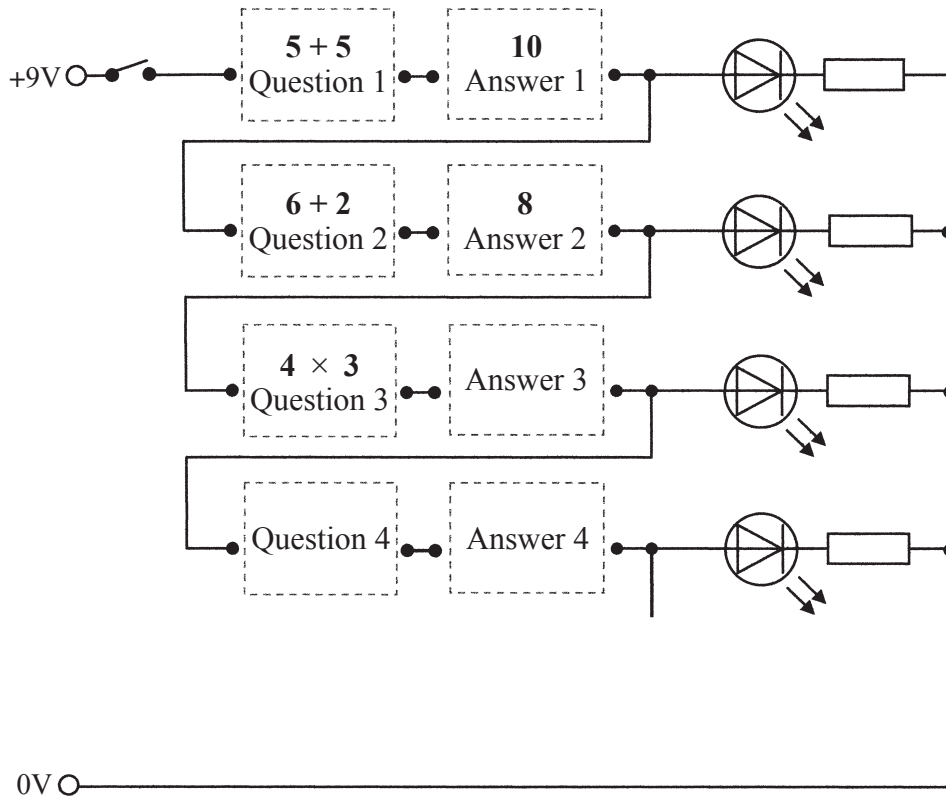
- (iii) Use notes and drawings to show clearly how the circuit is securely held in place.  
Quality of solution *(2 marks)*  
Quality of drawing *(2 marks)*

**QUESTION 4 CONTINUES ON THE NEXT PAGE**

**Turn over ►**

(d) **Figure 11** shows the incomplete circuit for the toy.

When a correct answer is given an LED will turn on and the next question can be used. The toy will only work if the questions are answered in the correct order.



**Figure 11**

- (i) Complete **Figure 11** by adding a buzzer that will sound when **all four** questions have been answered correctly. (2 marks)
- (ii) Give the names of **two** different sensors or switching devices that could be used to detect when a question block is placed in the toy.

1 .....

2 .....

(2 marks)

(e) Modern manufacturing methods using Computer Aided Manufacture (CAM) can provide many advantages.

List **two** advantages that the use of CAM has for:

(i) manufacturers;

1 .....

2 .....

(2 marks)

(ii) consumers.

1 .....

2 .....

(2 marks)

(f) Explain **one** method of testing the toy as part of a final evaluation.

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

(2 marks)

**TURN OVER FOR THE NEXT QUESTION**

- 5 Manufacturers have always had to balance the cost of developing and making a product against environmental considerations.

Shown below are key words that may be used when writing about environmental issues.

<b>Energy</b>	<b>Ecosystems</b>	<b>Availability</b>	<b>Waste</b>
<b>Pollution</b>	<b>Sustainable</b>	<b>Resources</b>	<b>Extraction</b>
<b>Workers' Conditions</b>	<b>Public Health</b>	<b>Waste Disposal</b>	<b>Recycling</b>

Complete the table, **Figure 12**, by adding the environmental considerations that the manufacturer should take at each of the stages of the production and life cycle of a product.

You may find some of the key words helpful.



Stage	Environmental Considerations
Selection of raw materials for product	1 <i>When raw materials are removed, habitats, eco systems might be damaged.</i>
	2
During manufacture	1
	2
Final product in use	1 <i>The type of pollutants given off when being used could be harmful to the person who is using the product.</i>
	2
End of use	1 <i>Danger to public health if materials or components cannot be disposed of safely.</i>
	2

Figure 12

(5 marks)



END OF QUESTIONS