OCR
RECOGNISING ACHIEVEMENT

GCSE

D&T ELECTRONIC PRODUCTS **1953/02**

D&T ELECTRONIC PRODUCTS (Short Course) **1053/02**

Paper 2 **(Higher Tier)**

H

D&T SYSTEMS & CONTROL TECHNOLOGY (ELECTRONICS OPTION) **1957/04**

Paper 4 **(Higher Tier)**

Afternoon Time: 1 hour 15 minutes

TUESDAY 5 JUNE 2007

Candidates answer on the question paper
Additional materials:
No additional materials are required.

CUP/T24690

Candidate Name

Centre Number

Candidate Number

INSTRUCTIONS TO CANDIDATES

- Write your name, Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Use blue or 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.
- Show all working for calculations.
- Do **not** write on the bar code.
- Do **not** write outside the box bordering each page.
- WRITE YOUR ANSWER TO EACH QUESTION IN THE SPACE PROVIDED. ANSWERS WRITTEN ELSEWHERE WILL NOT BE MARKED.

INFORMATION FOR CANDIDATES

- The number of marks for each question is given in brackets [ ] at the end of each question or part question.
- Marks will be awarded for the use of correct conventions.
- Dimensions are in mm unless stated otherwise.

FOR EXAMINER'S USE	
Q1	
Q2	
Q3	
Q4	
Q5	
TOTAL	

This document consists of **15** printed pages and **1** blank page.

1 Many of the items used in modern life make use of electronic circuits.
Three examples are shown in Fig. 1.

Hot air hand drier

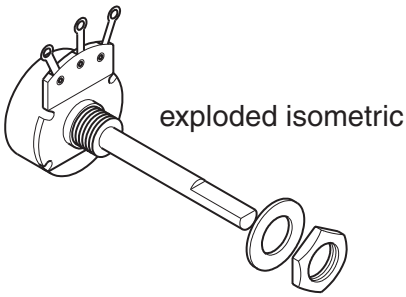
Personal computer

Calculator

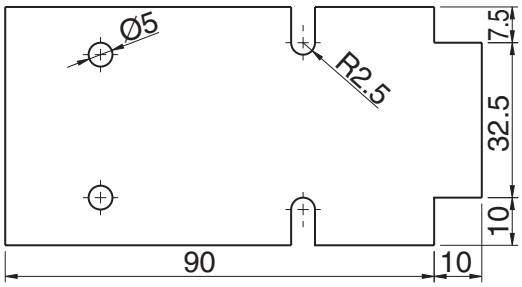
Fig. 1

(a) Different styles of drawing can be produced using CAD as shown in Fig. 2.

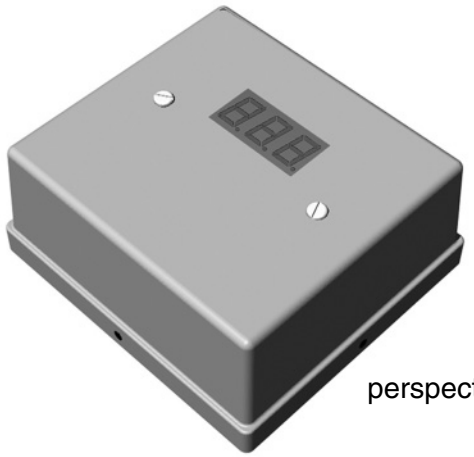
(i) For each style state the likely end user of that drawing.



exploded isometric



dimensioned orthographic



perspective

Fig. 2

exploded isometric .....[1]

dimensioned orthographic .....[1]

perspective .....[1]

(ii) A drawing of a mounting hole in the corner of a circuit board is shown in Fig. 3. The tolerance of the hole diameter is shown as $^{+0.2}$

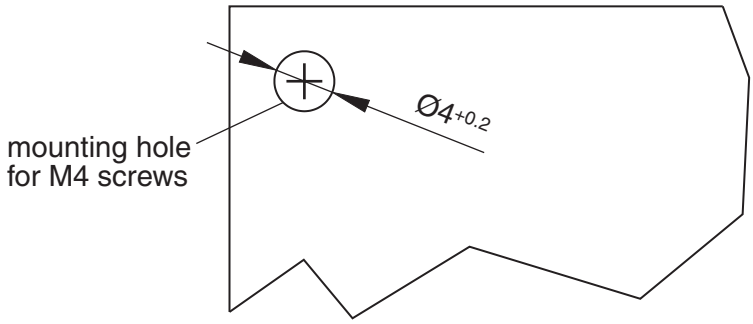


Fig. 3

State the largest drill size that can be used to produce the hole to the dimension shown.

.....[1]

(iii) Give the reason for **not** using a minus tolerance in this case.

.....[1]

(b) Circuit drawings produced on a CAD system can normally be used to generate parts lists. Describe how that information can help the manufacturer to operate a 'Just in Time' system.

.....

.....

.....[2]

(c) Electronic systems are often produced using small 'plug together' boards as shown in Fig. 4.

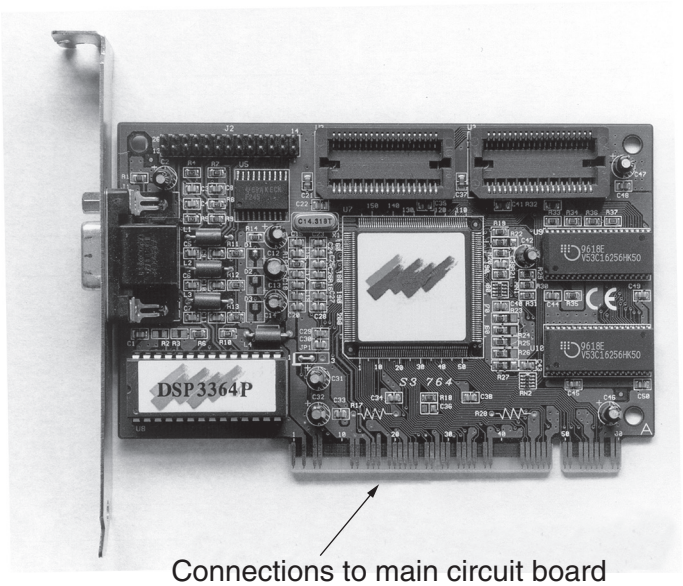


Fig. 4

(i) Use of 'plug together' boards can help with quality control.
Give **two** quality control advantages of using 'plug together' boards.

1 .....

.....[1]

2 .....

.....[1]

(ii) Plug together boards are not normally repaired if they develop a fault.
Give **one** reason for this.

.....

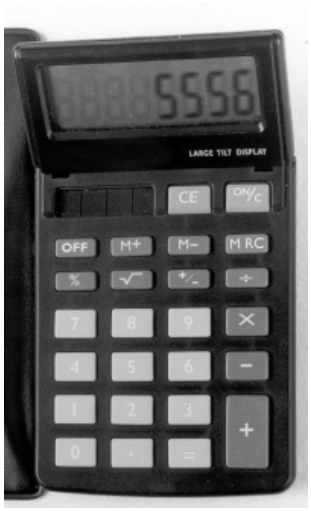
.....[1]

[Total: 10]

2 Electronic calculators have been readily available for about 30 years.
Three examples are shown in Fig. 5.

early model
LED display
(1973)

small LCD
display (1985)



large adjustable LCD
display (2002)

Fig. 5

(a) (i) Give **one** benefit of using an LED display.

.....

.....[1]

(ii) Give **one** benefit of using an LCD display.

.....

.....[1]

(b) (i) Calculator cases are injection moulded.
Give **two** reasons for this process being used.

Reason 1 .....

.....

Reason 2 .....

.....[2]

(ii) Fig. 6 shows the battery cover on the 1985 calculator held in place by a clip that is part of the moulding.
Give **one** property that is required from the plastic used in the battery cover.

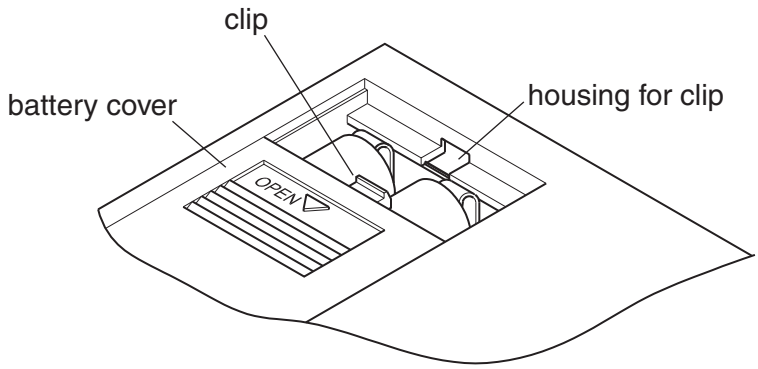


Fig. 6

.....[1]

(c) Fig. 7 shows a key removed from the 1985 calculator keypad.

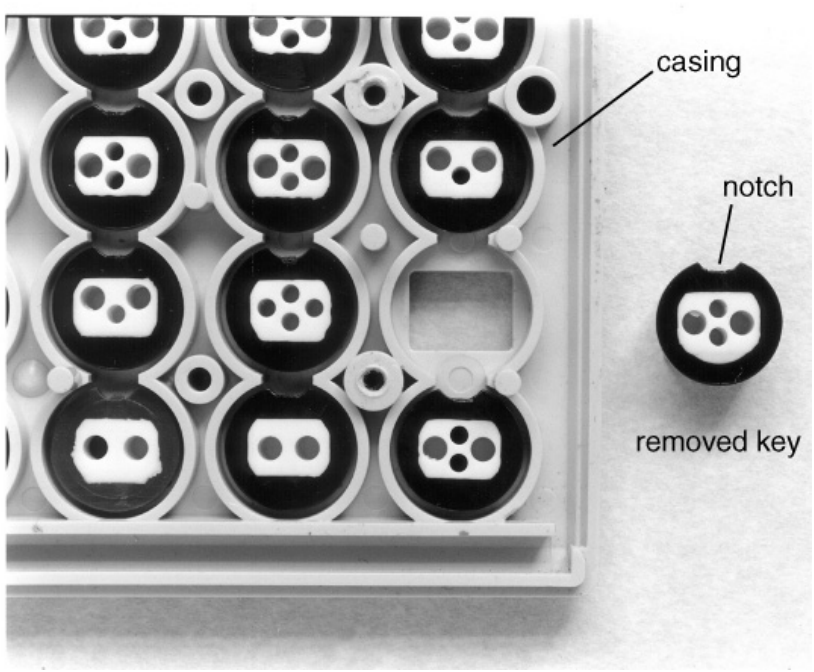


Fig. 7

(i) State the reason for the notch in the key.

.....[1]

(ii) The 1985 calculator has approximately 60 parts used in the final assembly.
Give **two** reasons for manufacturers trying to reduce the number of parts in a product.

1 .....

.....[1]

2 .....

.....[1]

(d) A view of a keypad is shown in Fig. 8.
A signal is sent when the conductive rubber pad is pressed, making an electrical connection between two points on the circuit board.

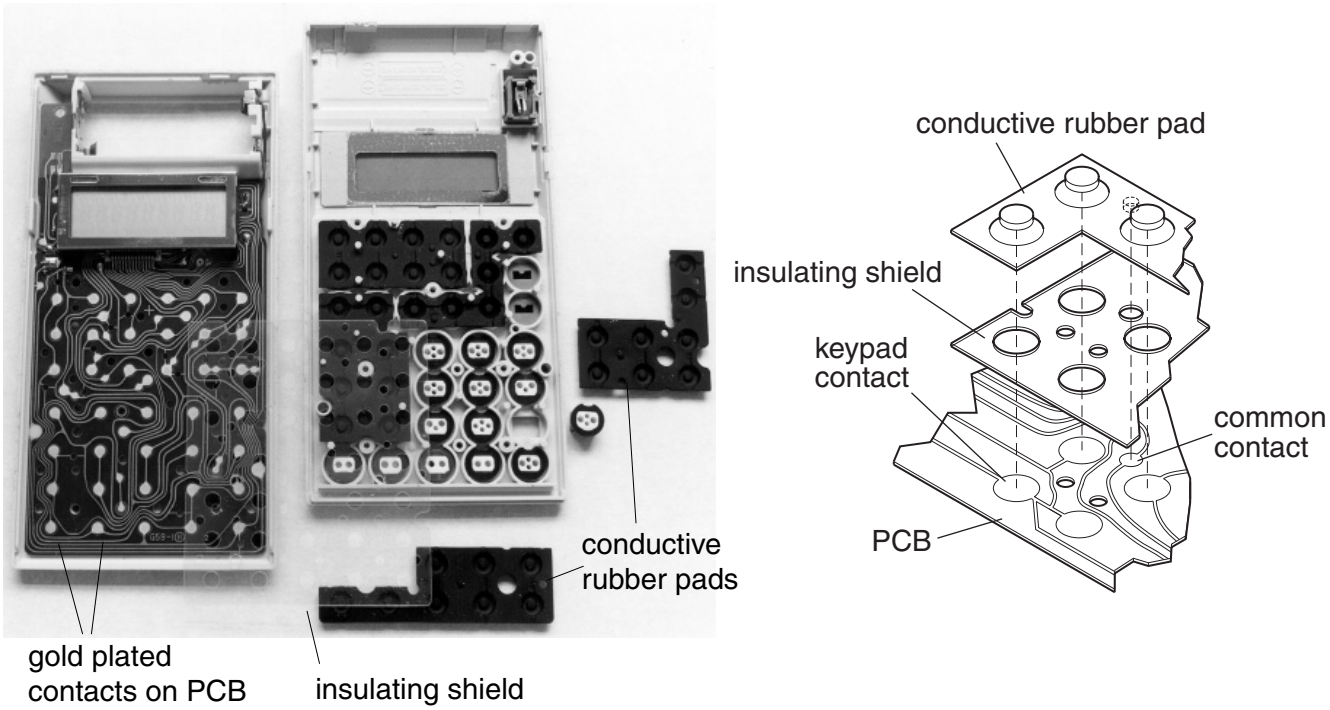


Fig. 8

Explain why this system is preferred to using conventional switches with metal contacts.

.....

.....

.....[2]

[Total: 10]

3 **(a)** A manufacturer of hot air hand driers is developing a new model.
Fig. 9 shows a hot air hand drier and a block diagram of the new circuit.

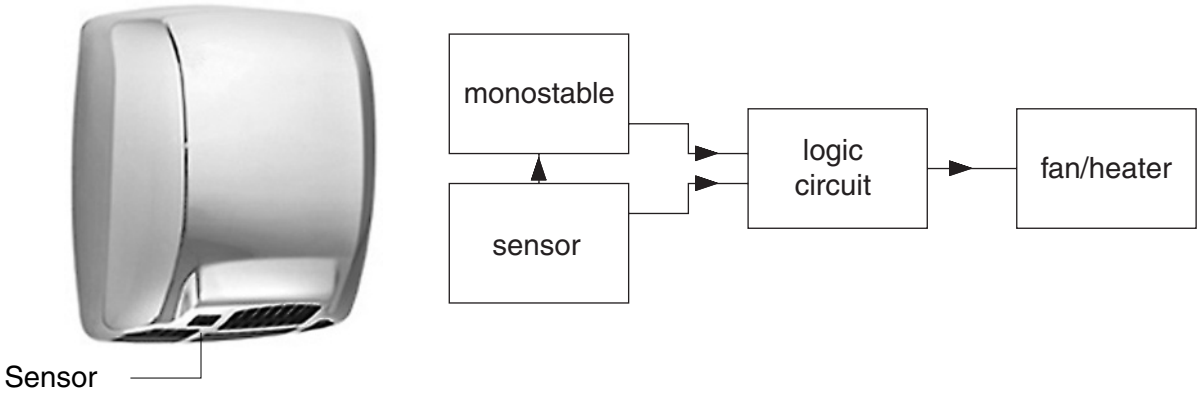


Fig. 9

- The drier starts when an LDR is shaded by a hand being placed under the base of the drier.
- The logic circuit combines a signal from the sensor with a signal from the monostable timing circuit to control the switching of the drier.
- After one minute the drier automatically switches off if the hands are no longer under the drier.

(i) Give **two** stages in the development of an **accurate** one minute time delay using a monostable circuit.

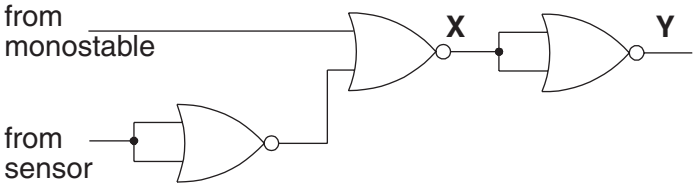
1 .....

2 .....[2]

(ii) It would be possible to use a PIC controller to replace the sensor and monostable.
Give **one** functional advantage of using a PIC controller.

.....[1]

(b) **(i)** The logic circuit to control the fan / heater is shown in Fig. 10.
Complete the truth table for the circuit.



monostable	sensor	X	Y
0	0		
0	1		
1	0		
1	1		

Fig. 10 [2]

(ii) The circuit is to be constructed using a quad 2 input NOR integrated circuit. Complete the diagram in Fig. 11 to show the connections to the logic IC. Connections must not be drawn inside the IC outline.

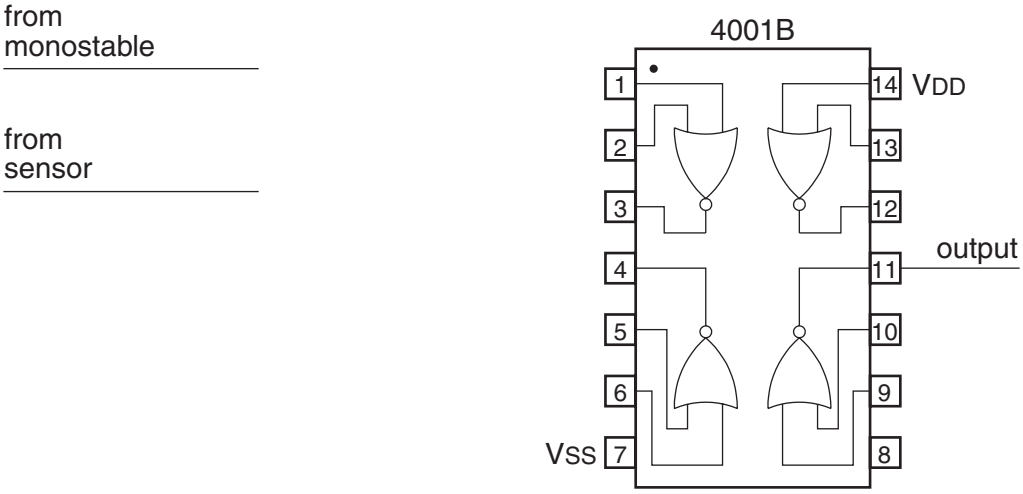


Fig. 11 [2]

(c) The fan and heater of the drier use a 230V AC supply.
Complete Fig. 12 to show how the output from the logic IC can be amplified to operate a relay.

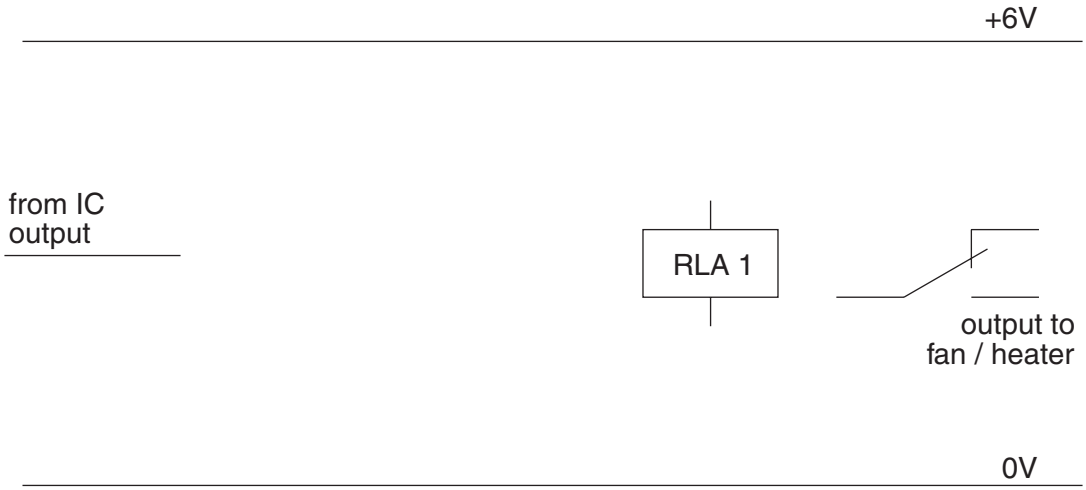


Fig. 12

[2]

(d) Users of the drier will have wet hands.
Give **one** precaution that the designer of the system can take to ensure that it is safe.

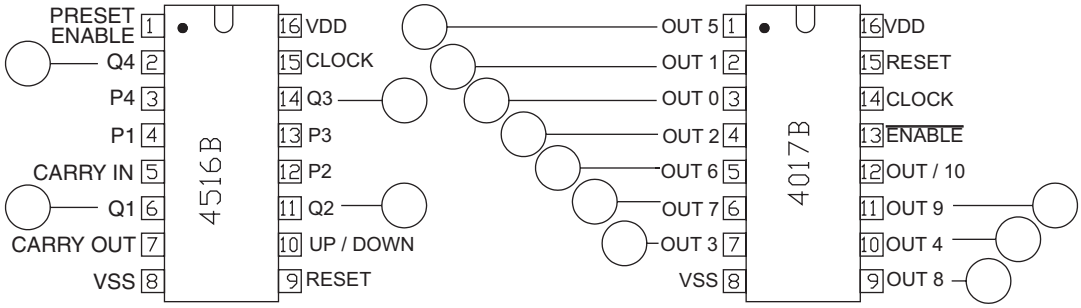
.....

.....[1]

[Total: 10]

4 A device to time pasta cooking is being developed as a school project.
The maximum time required is 9 minutes; this is measured using a 555 astable circuit which sends a pulse every 60 seconds to advance a counter IC.

(a) Fig. 13 shows two types of counter IC with outputs marked and descriptions of how they work.



4516B a counter with 4 bit binary output on pins Q1 – Q4. (Q1 = bit 0)
It can also be preset to a particular number using the preset pins P1 – P4 and the preset enable.

4017B a decade counter that outputs from 0 to 9 in sequence. The output pins go high when that number in the count has been reached. The device starts with output 0 high.

Fig. 13

The counter IC outputs indicate the number of low to high pulses that have taken place on the astable.

(i) Complete Fig. 13 to show the logic level of each output after **five** low to high pulses. [2]

(ii) Give **one** advantage of each IC for this application.

4516B .....

.....[1]

4017B .....

.....[1]

(b) Fig. 14 shows part of the circuit for the timer.
To cause a reset on both ICs:

- the reset pin on the astable should be connected **low** ; and
- the counter IC reset pin should be connected **high**.

Complete the connections to allow a single switch to operate both resets.

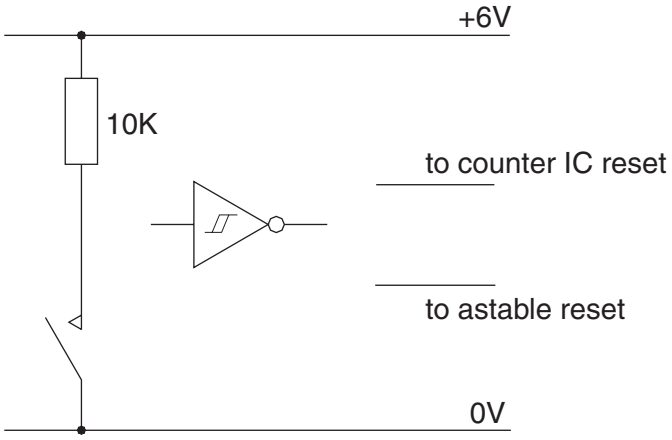


Fig. 14 [2]

(c) The 4017B is chosen for the counter circuit.
The output is used to operate LEDs indicating the progress of the count and the amount of time that has passed.
Fig. 15 shows the connections for the LEDs.

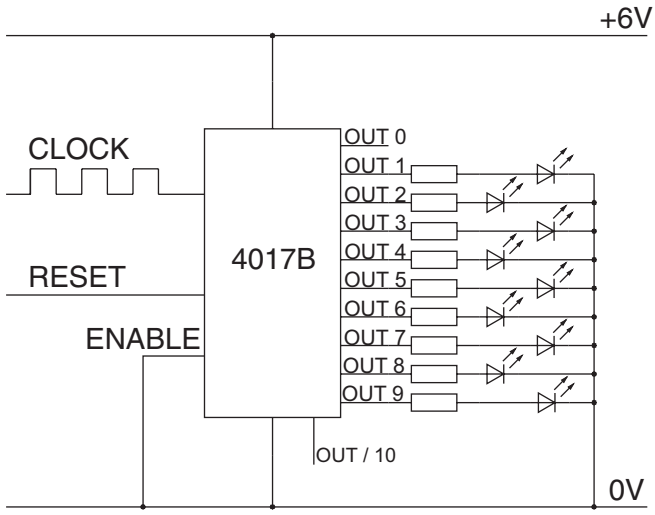


Fig. 15

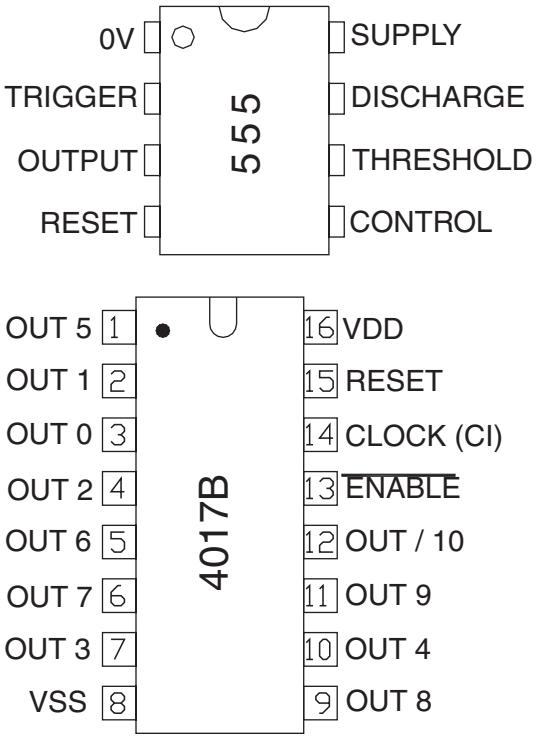
Give the reason for not using output 0.

.....

.....[1]

(d) Fig. 16 shows the partly completed breadboard of the decade counter circuit.
Add the following connection wires, showing clearly which holes have been used.
Each hole in the breadboard can only be used once.

1. Output of astable to clock input (CI)
2. Enable pin to 0V
3. 555 timer 0V connection



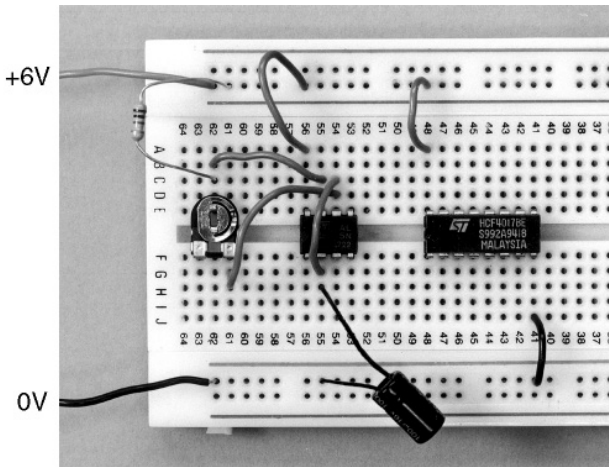


Fig. 16 [3]

[Total: 10]

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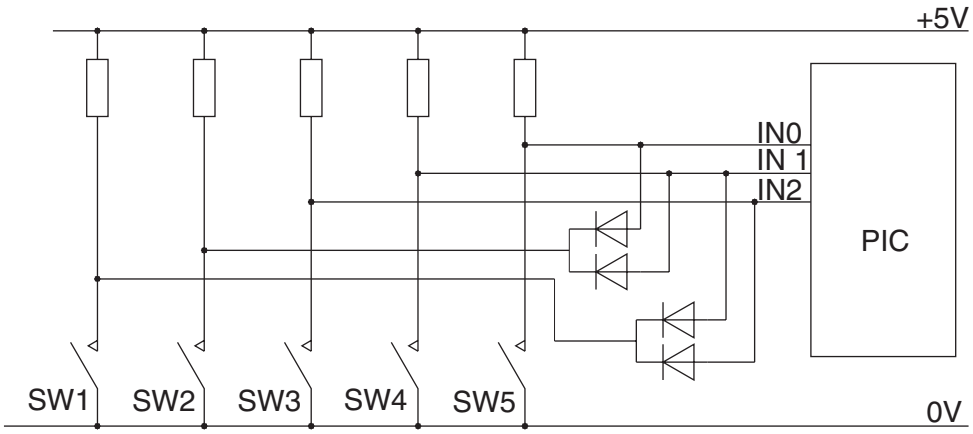
QUESTION 5 BEGINS ON PAGE 14.

5 PIC microcontrollers are increasingly used in electronics.
The limited number of inputs available can be a problem for the circuit designer.
Fig. 17 shows one way of increasing the number of inputs that can be recognised.



	CLOSED	IN 0	IN 1	IN 2
SW1	✓	0	1	1
SW2	✓	1	1	0
SW3	✓	0	0	1
SW4	✓	0	1	0
SW5	✓	1	0	0

Fig. 17

(a) (i) Explain the purpose of the diodes.

.....

.....

.....[2]

(ii) State the maximum number of high / low signal combinations that are available using **three** inputs.

.....[1]

(b) (i) The design from Fig. 17 is converted into a PCB using a CAD program with auto-routing shown in FIg. 18.
Two of the tracks are not routed, these are shown as thin lines.
Complete the layout by routing these two tracks.

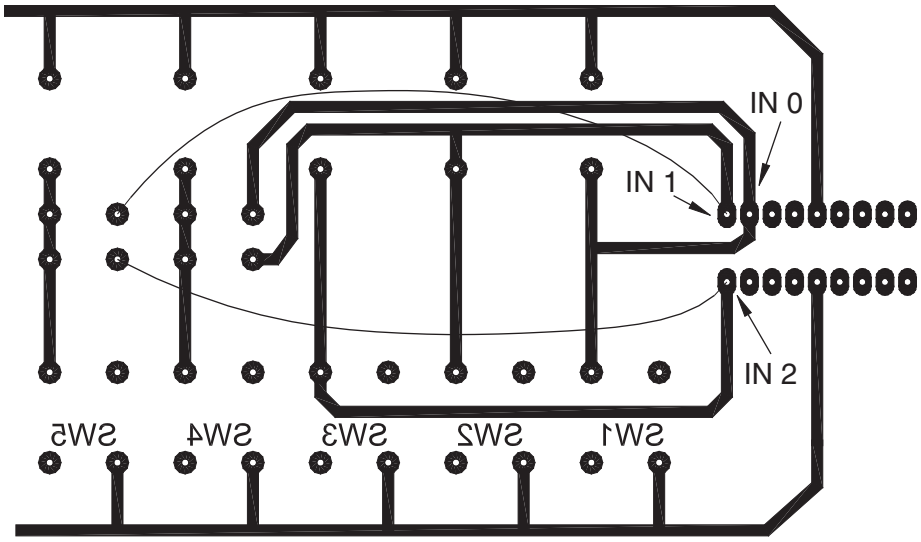


Fig. 18 [2]

(ii) PCB auto-routing software offers a number of options for the user in the way that the final layout is produced.
Give **one** feature that can be controlled as an option.

.....

.....[1]

(c) Fig. 19 shows a new *smart* material known as QTC that can be used for switch construction.
When it is compressed it will begin to conduct, the resistance falls as pressure on the material is increased.
When used as part of a push switch it will reduce arcing and control contact bounce effectively.
Give **two** circuit applications where the use of this switch would be beneficial.

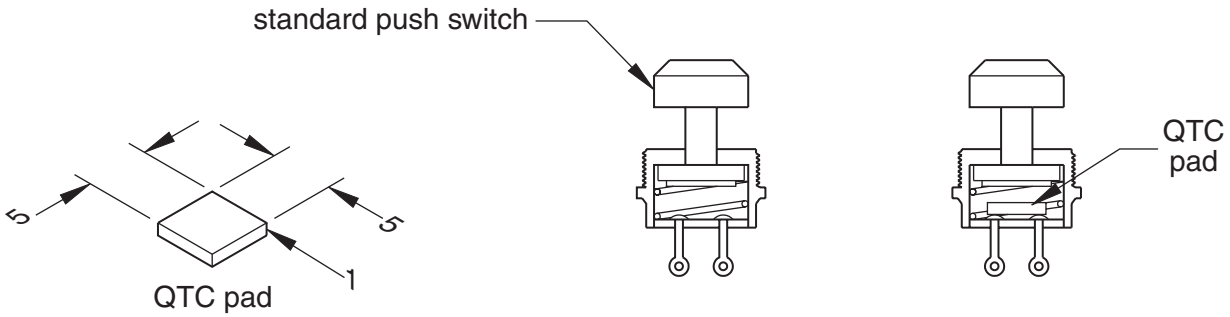


Fig. 19

1.....

.....

2.....

.....[2]

(d) From 2006 all solder used in electronic manufacturing has to be lead free.
Describe **two** problems with enforcing this ruling.

1.....

.....

2.....

.....[2]

[Total: 10]