

Wednesday 22 May 2013 – Afternoon

**GCSE DESIGN AND TECHNOLOGY
Electronics and Control Systems**

A514/01 Technical Aspects of Designing and Making: Electronics

Candidates answer on the Question Paper.

OCR supplied materials:

None

Other materials required:

- A calculator may be used

Duration: 1 hour 15 minutes



Candidate forename		Candidate surname	
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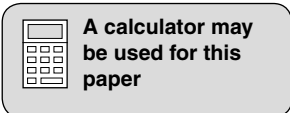
Centre number							Candidate number				
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INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions in **Section A and Section B**.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Show all your working out for calculations.
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

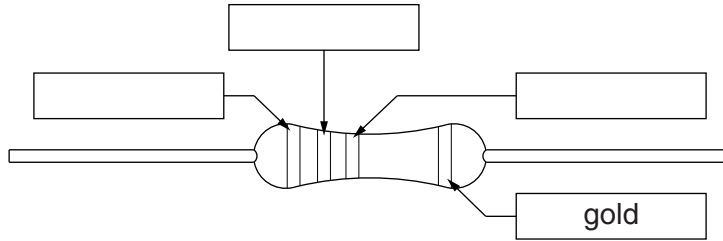
- The number of marks is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is **60**.
- Marks will be awarded for the use of correct conventions.
- Your Quality of Written Communication will be assessed in questions marked with an asterisk (*).
- Dimensions are in millimetres unless stated otherwise.
- This document consists of **16** pages. Any blank pages are indicated.



SECTION A

Answer **all** questions.

- 1 (a) (i) Fig. 1 shows a fixed resistor with a value of 5K6.
Use information from the table to complete the colour code on the resistor.



1st Colour Band 1st Digit		2nd Colour Band 2nd Digit		3rd Colour Band Number of Zeros		4th Colour Band Tolerance %	
Black	0	Black	0	Black	0		
Brown	1	Brown	1	Brown	1	Brown	1
Red	2	Red	2	Red	2	Red	2
Orange	3	Orange	3	Orange	3		
Yellow	4	Yellow	4	Yellow	4		
Green	5	Green	5	Green	5		
Blue	6	Blue	6	Blue	6		
Violet	7	Violet	7	Violet	7		
Grey	8	Grey	8	Silver	0.01	Silver	10
White	9	White	9	Gold	0.1	Gold	5

Fig. 1

[3]

- (ii) The tolerance of the 5K6 resistor is 5%.
State the range of resistance that may be found in a batch of these resistors.

Upper value

Lower value

[2]

(b) Fig. 2 shows three ways of using resistors to assemble a potential divider circuit.

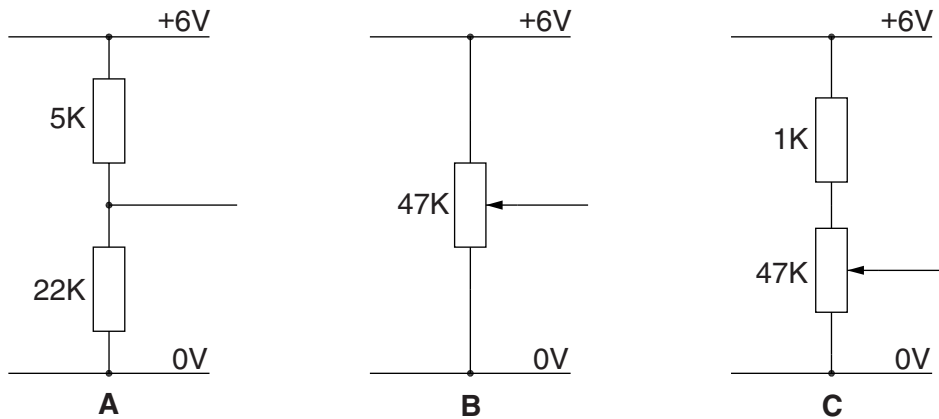


Fig. 2

(i) Describe the benefits of method C compared to methods A or B.

.....

.....

.....

..... [2]

(ii) Calculate the output voltage for method A.

Use the formula $\text{Voltage out} = \frac{R_2}{R_1 + R_2} \times \text{supply voltage}.$

.....

.....

..... [2]

(c) A multimeter can be used to measure the output voltage when the potential divider is set up on a breadboard.

Complete Fig. 3 to show:

- The position of the multimeter probes when checking the output voltage of the potential divider
- The correct position for the multimeter switch.

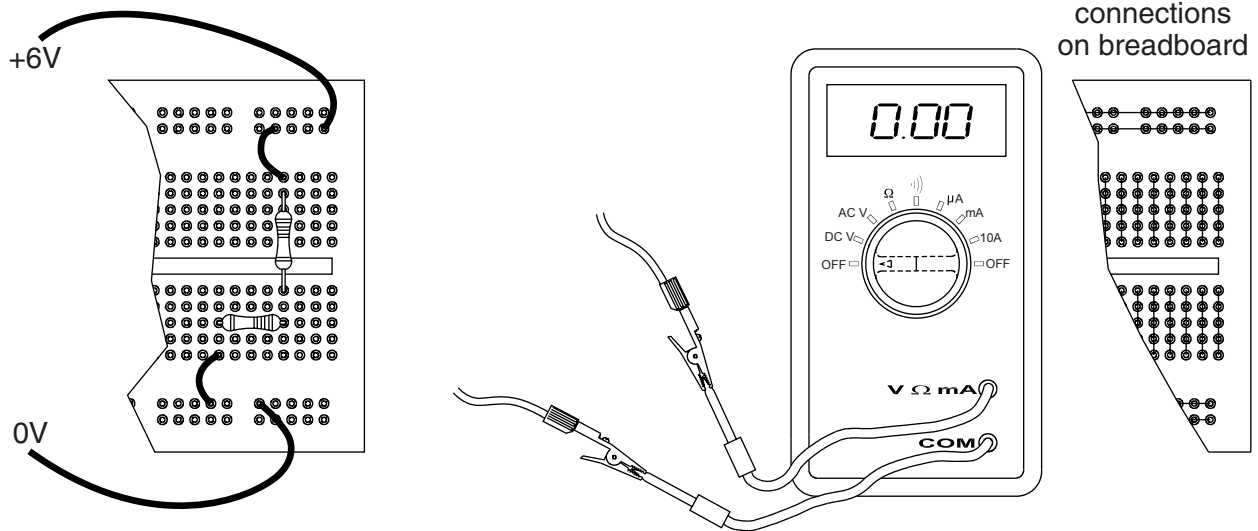


Fig. 3

[3]

[Total: 12]

- 2 (a) Fig. 4 shows a carbon monoxide alarm of the type installed in many homes. It is used to give a warning when carbon monoxide from a faulty heating appliance is detected. The casing for the alarm is manufactured from ABS.



Fig. 4

- (i) State the process that has been used to manufacture the casing.
 [1]
- (ii) Give **one** property of ABS that makes it a suitable material for the casing.
 [1]
- (iii) The casing of the alarm has been clipped together rather than using screws. The clips can be seen in Fig. 5.

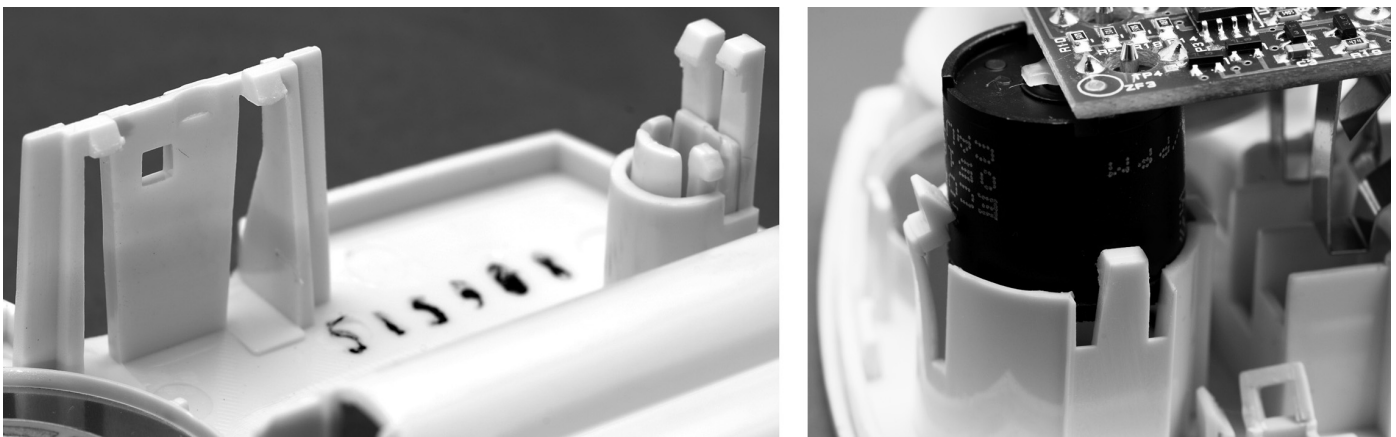


Fig. 5

- Give **one** possible reason for this method of assembling the casing parts.
-
- [1]

(b) Fig. 6 shows the top and base of the circuit board.

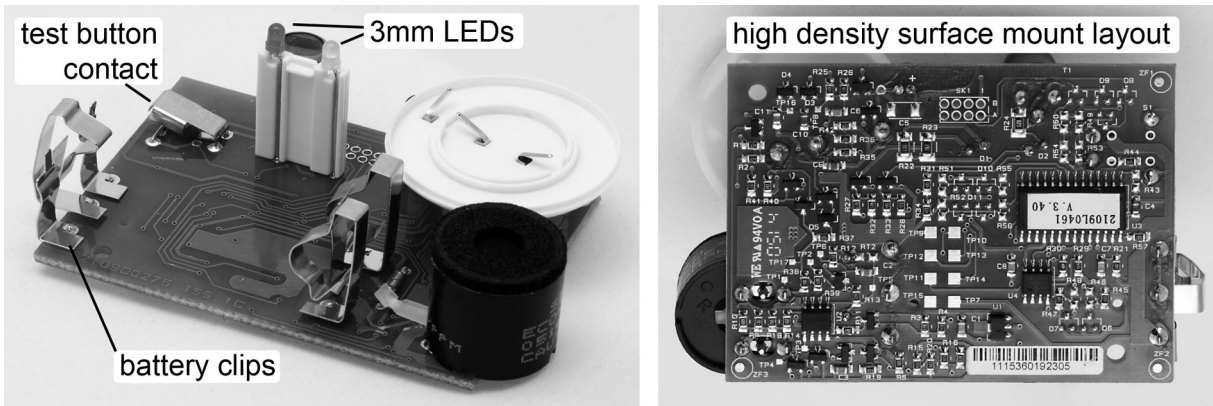


Fig. 6

- (i) The test button contact and battery clips are made from electro plated brass. Tick (✓) **two** properties that this material should have.

Will Not Bend	Electrical Conductor	Magnetic	Electrical Insulator	Resists Corrosion

[2]

- (ii) Standard 3mm LEDs are used to indicate battery power and alarm state. The LEDs have been fitted over a plastic block as shown in Fig. 7.



Fig. 7

Describe the purpose of the plastic block.

.....

.....

.....

[2]

(iii) The circuit board uses surface mount components.
Give **two** reasons why this type of construction is widely used in modern electronic products.

- 1
-
- 2
-

[2]

(c) A close up view of the circuit board in Fig. 8 shows eight of the test points that are grouped together in the circuit.

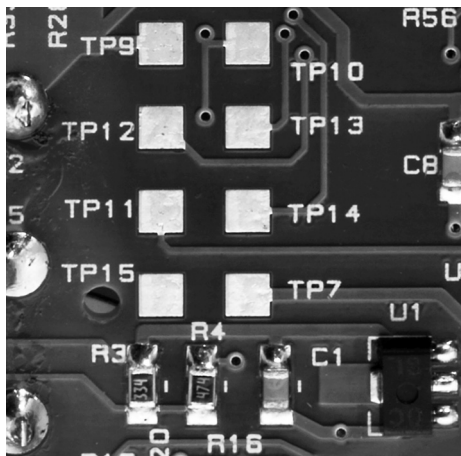


Fig. 8

Give **three** reasons for designing test points into a PCB layout.

- 1
-
- 2
-
- 3
-

[3]

[Total: 12]

- 3 (a) Fig. 9 shows a hand-held drill **A** and a small pillar drill **B**, used for drilling component holes in a PCB.



Fig. 9

- (i) State **one** advantage of the pillar drill when compared to the hand-held drill.

..... [1]

- (ii) The speed of rotation on the pillar drill can be adjusted by moving the belt on the stepped pulleys shown in Fig. 10. The speeds available are 5000 rpm, 6500 rpm and 8500 rpm. State the speed setting of the drill shown in Fig. 10.

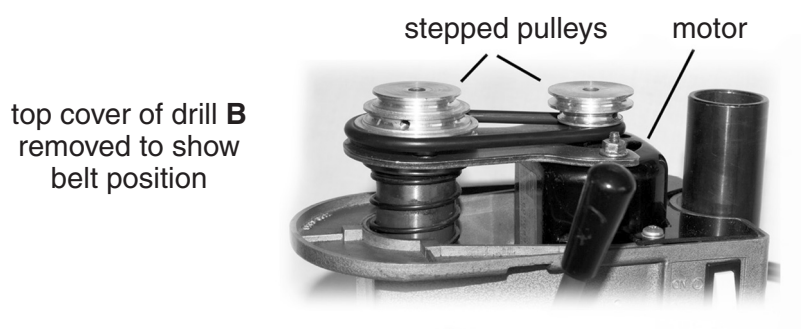


Fig. 10

..... [1]

(b) Fig. 11 shows part of the track side of a PCB before it is drilled.

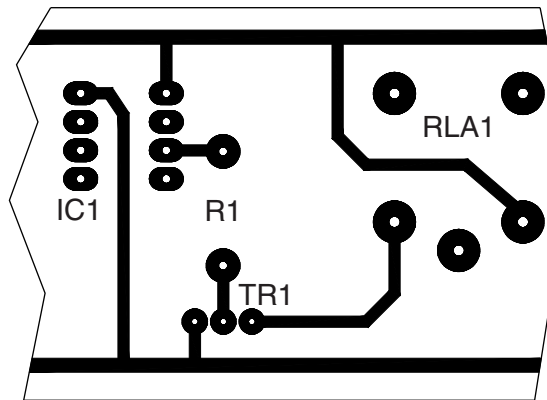


Fig. 11

Explain why the pad spacing and drilling for RLA1 and IC1 need to be more accurate than the pad spacing and drilling for R1 and TR1.

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.....

.....

..... [2]

(c) Fig. 12 shows a micrometer and a digital caliper being used to measure the diameter of a power transistor leg.

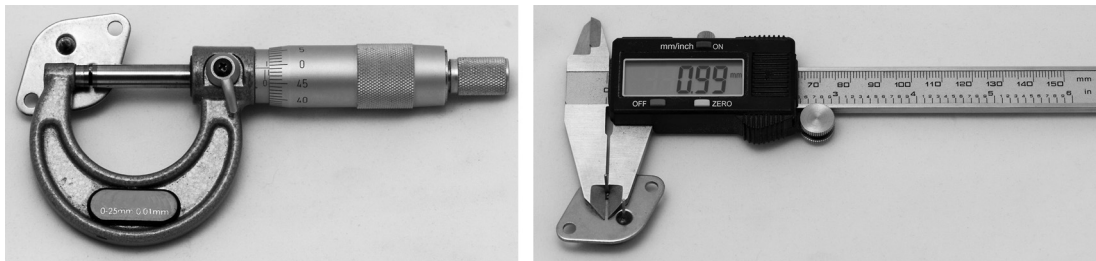


Fig. 12

Give **two** reasons why the digital caliper may be a better choice of tool for a school workshop.

1

.....

2

.....

[2]

11
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12
SECTION B

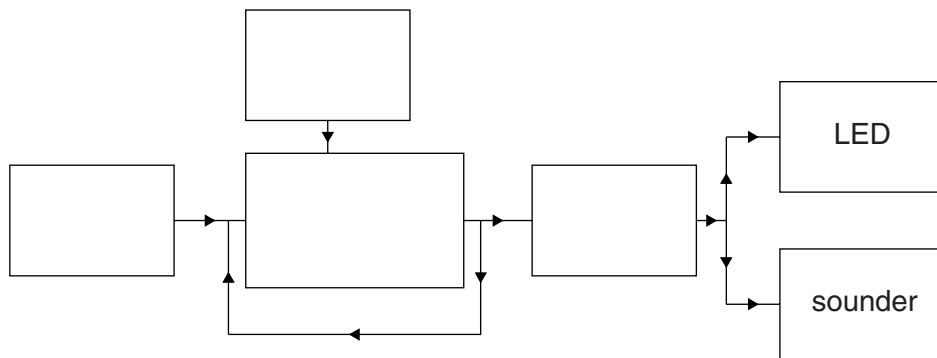
Answer **all** questions.

4 A circuit is needed to give a visible and audible warning when the area in which the sensor is placed is hotter than 30°C.

Fig. 13 shows a block diagram for the circuit.

(a) Complete the block diagram for the circuit by adding names from the list below.

thermistor transistor amplifier comparator reference voltage

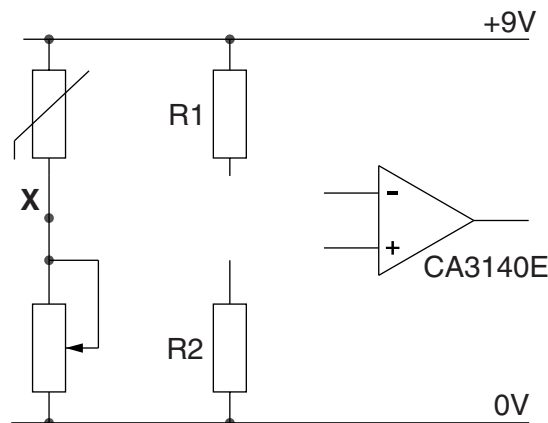


[3]

Fig. 13

(b) (i) Part of the circuit is shown in Fig. 14. Complete the circuit design to show:

- point X connected to the non-inverting terminal of CA3140E
- R1 and R2 connected as a potential divider with the divided voltage connected to the inverting terminal of CA3140E.



[2]

Fig. 14

(ii) Suggest values for R1 and R2 to give +4.5V at the inverting terminal.

Value for R1

Value for R2

[1]

- 5 Fig. 15 shows a hot air hand dryer. The hand dryer operates when a light sensor near the hot air outlet is shaded by the hands of the user.

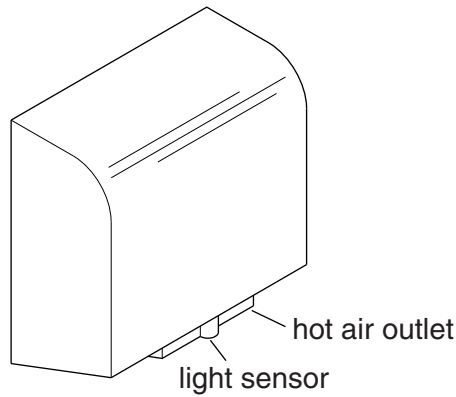


Fig. 15

- (a) A logic 1 signal from the light sensor is combined with a logic 1 signal from a monostable timer to switch on the hand dryer.

- (i) Complete the truth table for the circuit shown in Fig. 16.

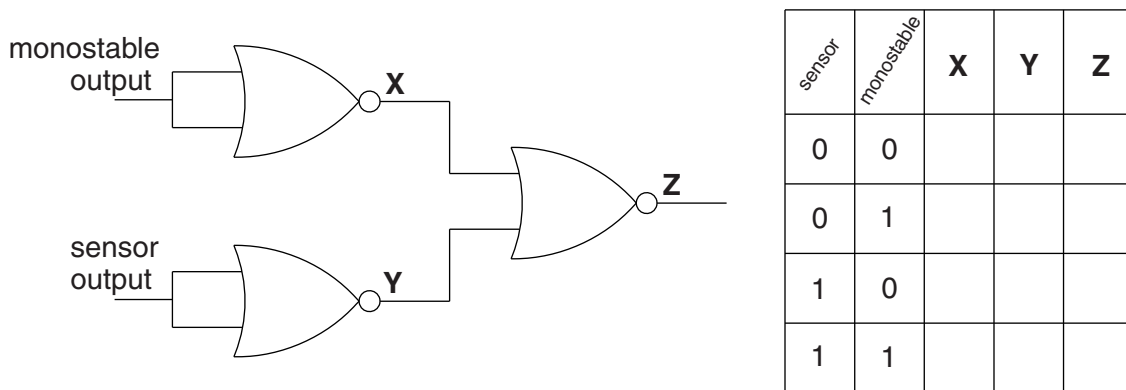


Fig. 16

[3]

- (ii) When the hand dryer is operated the monostable output changes from 0V to 6V for 15 seconds.

Complete Fig. 17 to show a graph of the monostable output.

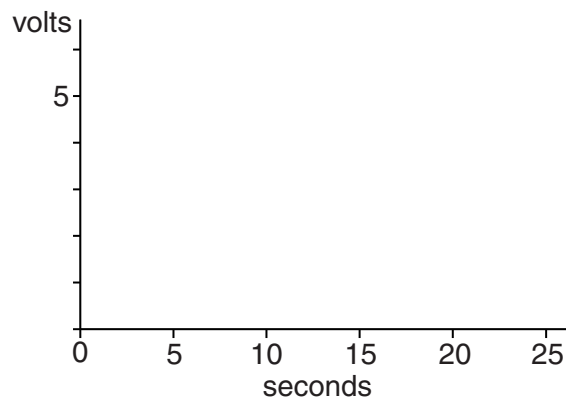


Fig. 17

[2]

- (b) (i) The logic circuit in Fig. 16 will use a quad 2 input NOR gate. Complete Fig. 18 to show connections to the logic IC.

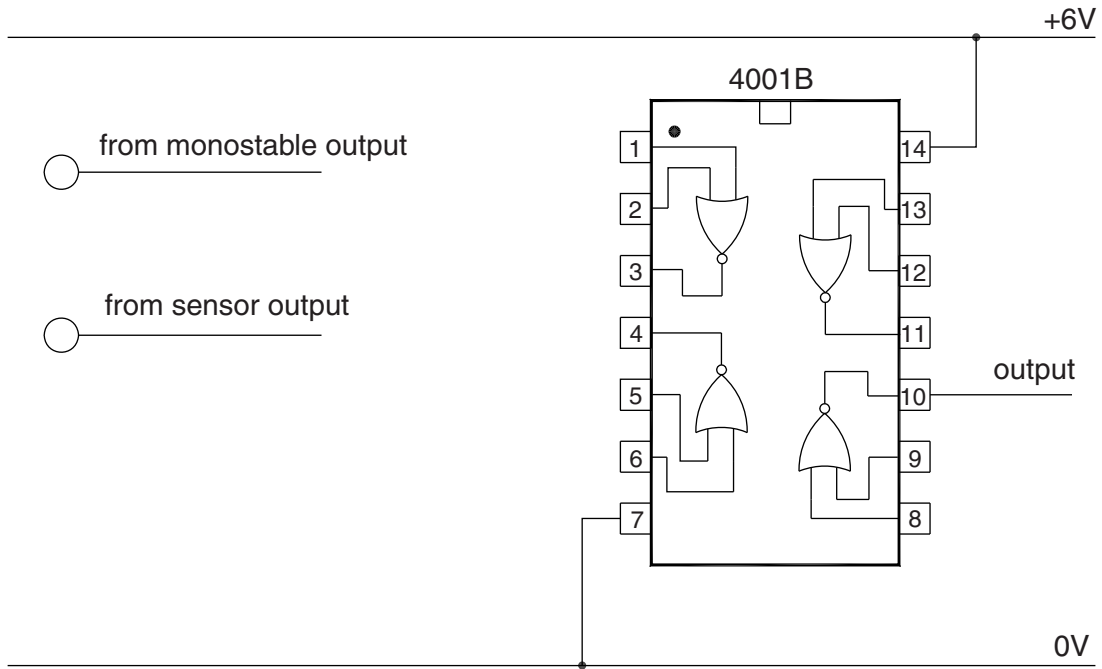


Fig. 18

[2]

- (ii) For reliable operation logic ICs should have the unused inputs connected to either the positive or the 0V rail. Add these connections to Fig. 18 on the logic gate that has not been used.

[1]

- (c) A PIC microcontroller could be used to replace the logic circuit and monostable timer. Give **two** benefits of using a PIC circuit for this application.

1

.....

2

.....

[2]

- (d) The hand dryer will use a 230V AC supply for the heater and fan. Describe **two** ways by which the designer can ensure that the device is electrically safe for the user.

.....

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.....

.....

[2]

[Total: 12]

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