

GENERAL CERTIFICATE OF SECONDARY EDUCATION

DESIGN AND TECHNOLOGY

Systems & Control Technology (Electronics Option)

Paper 3 (Foundation Tier)

1957/03

Candidates answer on the Question Paper

OCR Supplied Materials:

None

Other Materials Required:

None

Wednesday 26 May 2010

Afternoon

Duration: 1 hour



Candidate
Forename

Candidate
Surname

Centre Number

Candidate Number

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- 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 working for calculations.
- All necessary formulae are provided within the questions. No extra formulae sheet is required.

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 **50**.
- Marks will be awarded for the use of correct conventions.
- Dimensions are in mm unless stated otherwise.
- This document consists of **16** pages. Any blank pages are indicated.

2

- 1 Correct fitting of components in an electronic circuit is essential.
Fig. 1 shows five components that have to be fitted the correct way round in a circuit.

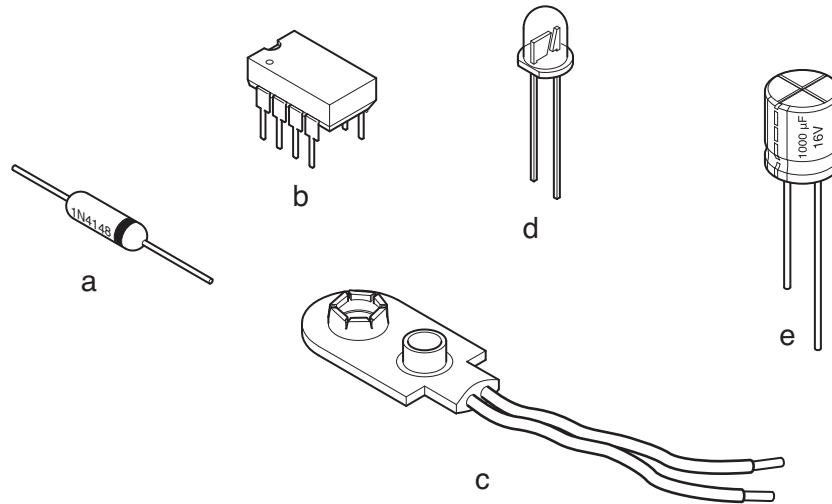


Fig. 1

- (a) (i) Complete the table below to show how each component can be correctly placed. One has been completed for you.

| feature on component | component |
|---------------------------|-----------|
| flat to show negative end | d |
| colour coded | |
| coloured band at one end | |
| notch or dot at pin 1 end | |
| negative leg is shorter | |

[4]

- (ii) Fig. 2 shows the information on the side of component **e** from Fig. 1. Give the meaning of each piece of information.

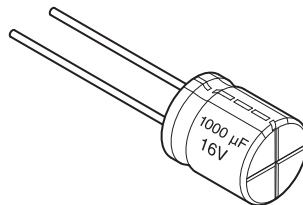


Fig. 2

1000 μF [1]

16V [1]

- (b) Circuit symbols are often printed on the top of a circuit board to show the position of a component.

(i) On Fig. 3 mark the correct hole for leg X.

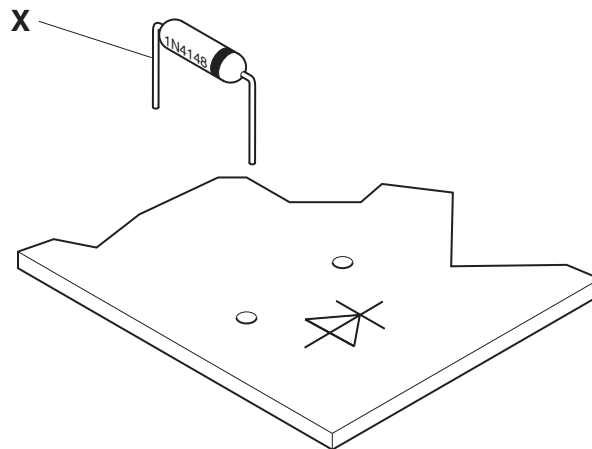


Fig. 3

[1]

- (ii) Give **one** possible result of operating the circuit with this component the wrong way round.

..... [1]

- (c) An IC holder is shown in Fig. 4.

Describe **two** benefits of using the holder rather than soldering an IC directly to a circuit board.

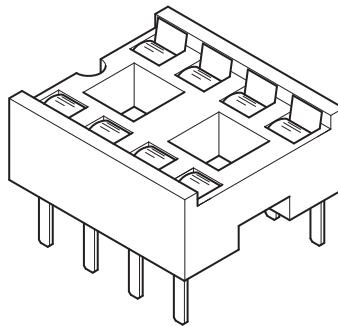


Fig. 4

Benefit 1 [1]

Benefit 2 [1]

[Total: 10]

- 2 A sensor for a greenhouse frost monitor is to be tested.
Fig. 5 shows an NTC thermistor being tested with a multimeter.

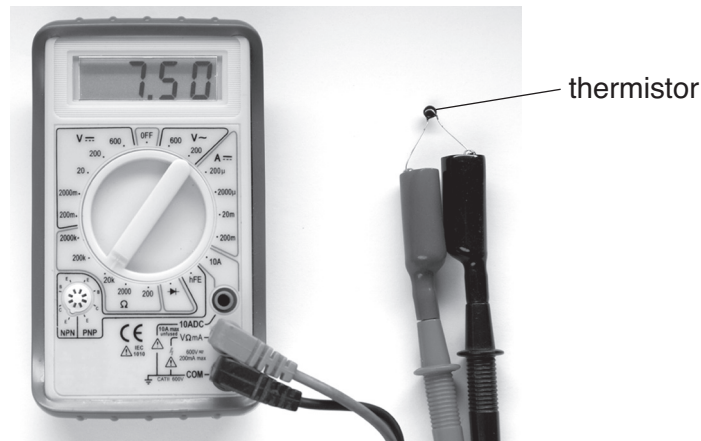


Fig. 5

- (a) (i) Describe what will happen to the reading if the thermistor is placed on a bag of ice.

..... [1]

- (ii) The comparator circuit for the frost monitor is shown in Fig. 6.
State the purpose of the resistors VR1 and R3.

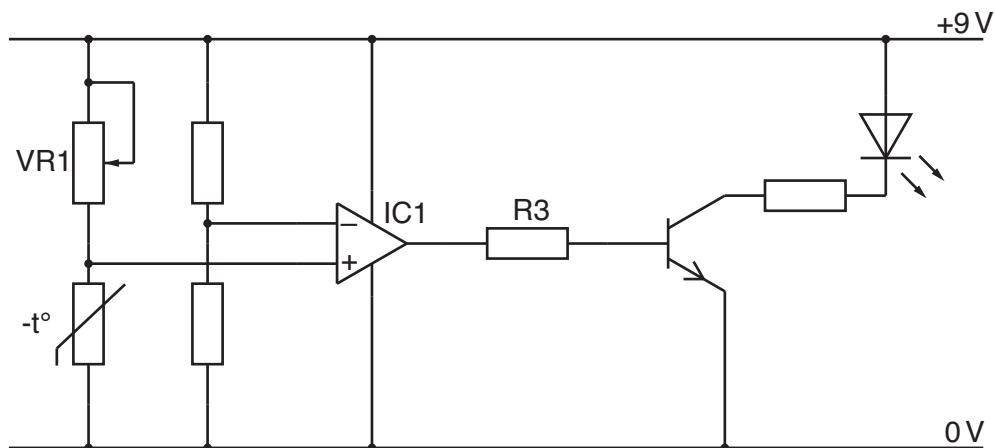


Fig. 6

Purpose of VR1 [1]

Purpose of R3 [1]

- (b) Fig. 7 shows the circuit symbol for IC1 next to the pin diagram.
Complete the pin numbers for each connection on the circuit symbol.

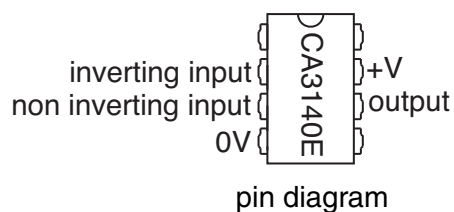
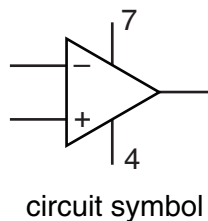


Fig. 7

[3]

- (c) Fig. 8 shows part of the solder side of the circuit board for the frost monitor. There are two faults visible on the soldering. State how each fault can be corrected.

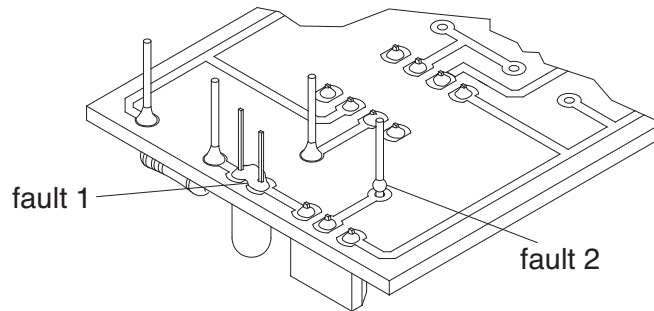


Fig. 8

Fault 1 [1]

Fault 2 [1]

- (d) A close up view of a piece of multicore solder with the flux visible is shown in Fig. 9.

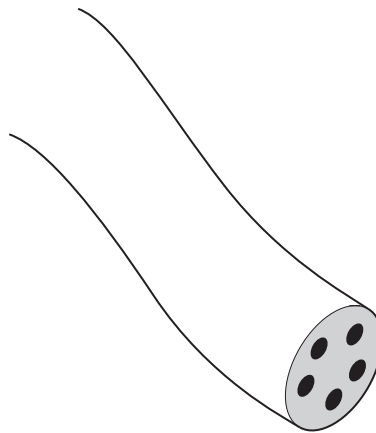


Fig. 9

(i) State the purpose of flux in solder. [1]

(ii) State the name of the metal that is no longer used in solder for commercial circuit manufacture. [1]

[Total: 10]

- 3 A simple alarm system for a garden shed uses a pressure pad to operate a latch in the circuit. The latch is reset with a key switch. Fig. 10 shows the latching part of the circuit and the truth table for the logic gate used.

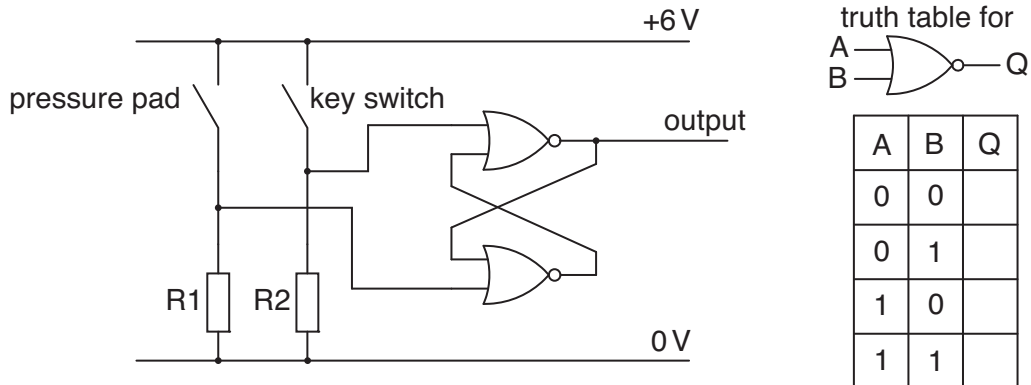


Fig. 10

- (a) (i) State the type of logic gate used in the system.

..... [1]

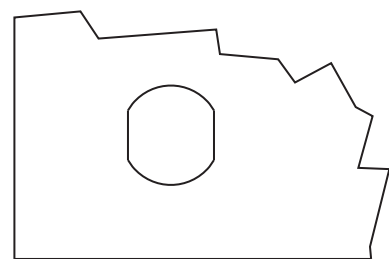
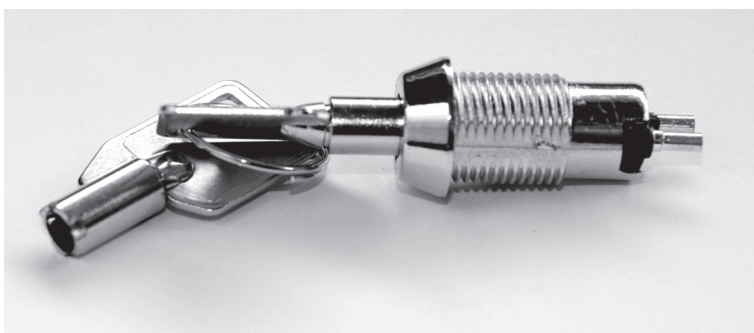
- (ii) Complete the truth table in Fig. 10 for the logic gate used.

[1]

- (iii) Resistors R1 and R2 are known as pull down resistors. Give the reason that they are essential in the circuit.

..... [1]

- (b) The key switch used when resetting the circuit requires a shaped hole in the casing as shown in Fig. 11.



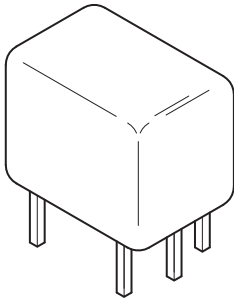
shaped hole for key switch

Fig. 11

Give the reason for **not** using a round hole.

..... [1]

- (c) A relay will be used to operate a siren.
Catalogue details of the relay chosen are shown in Fig. 12.



| | |
|-------------------|------------------|
| temperature range | −40 °C to +85 °C |
| contact rating | 10 A 250VDC |
| coil voltage | 6V |
| coil consumption | 360mW |
| operating time | 10mS |
| release time | 5mS |

Fig. 12

- (i) Calculate the current flow through the relay coil.
Use the formula $P = V \times I$.

.....

 [2]

- (ii) Give **two** benefits of using a relay to operate the siren.

Benefit 1 [1]

Benefit 2 [1]

- (iii) Complete Fig. 13 to show the operating circuit for the relay coil.

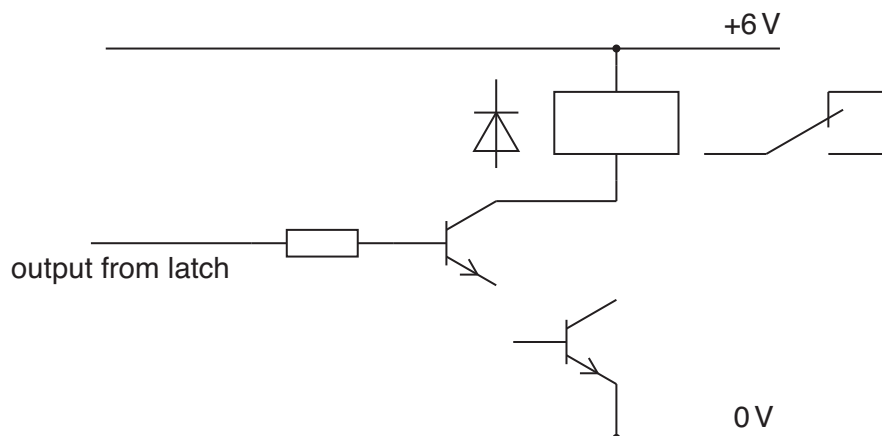


Fig. 13

[2]

[Total: 10]

- 4 Electronic product cases normally need holes drilling to allow the fitting of switches and external components.
2D CAD software has been used to draw a drill template.

(a) State **two** benefits of using CAD, rather than hand drawing, for the drill template design.

Benefit 1 [1]

Benefit 2 [1]

(b) Holes to match those in a PCB are included in the CAD drawing of a template shown in Fig. 14.

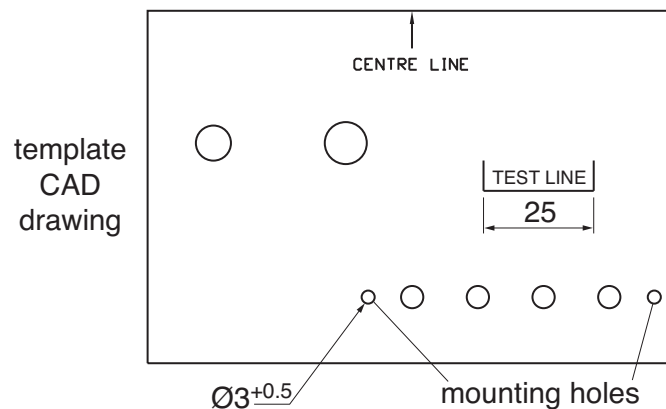


Fig. 14

The diameter of the mounting holes for the PCB is shown on the drawing as $\text{Ø}3^{+0.5}$, giving a tolerance of +0.5 mm.

Give the likely reason for allowing a tolerance on the hole diameter.

Reason [1]

(c) Output from the CAD drawing can be printed as a paper template or used in a laser cutter for production of an acrylic template.
Fig. 15 shows both outputs.

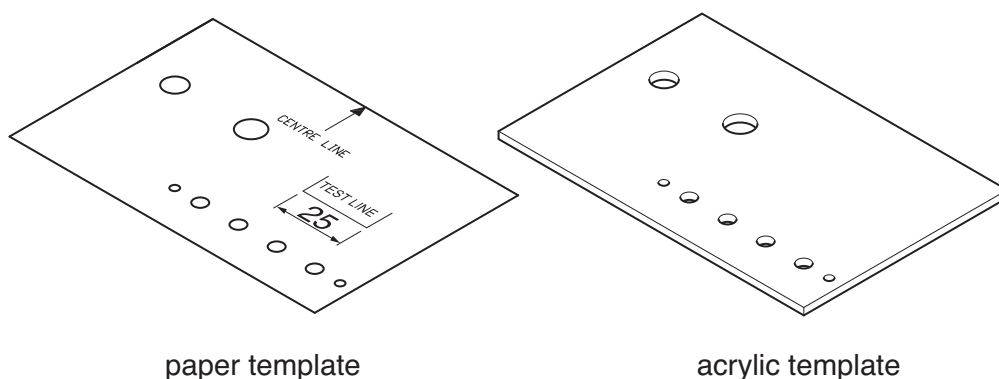


Fig. 15

(i) Give **one** method of checking the accuracy of the paper template before use.

..... [1]

- (ii) Explain why the laser cut template is likely to be more accurate in use than the paper template.

.....

 [2]

- (iii) Fig. 16 shows the laser cut template and the case lid that is to be drilled.

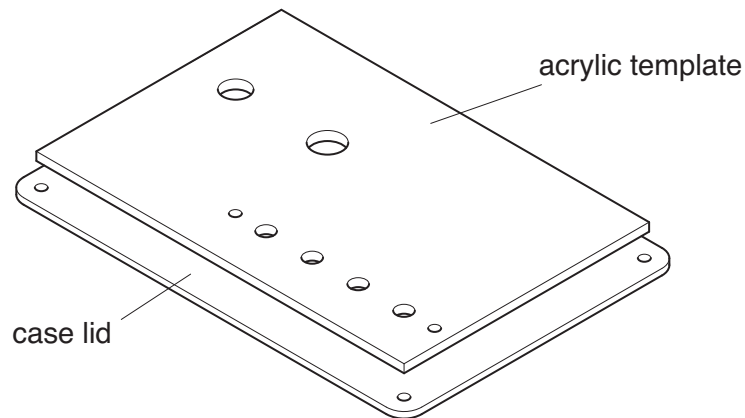


Fig. 16

Use notes or sketches to show a method of accurately securing the acrylic template to ensure that all the holes line up.

[2]

- (d) When an electronic product is no longer required it should be possible to recycle the materials.

Give **two** pieces of information that should be included on the case to make recycling easier.

1 [1]

2 [1]

[Total: 10]

Turn over

- 5 Fig. 17 shows a hand held detector used for finding concealed mains cable, other metals and timber framing. The device is powered by a 9V battery and includes a white LED torch.

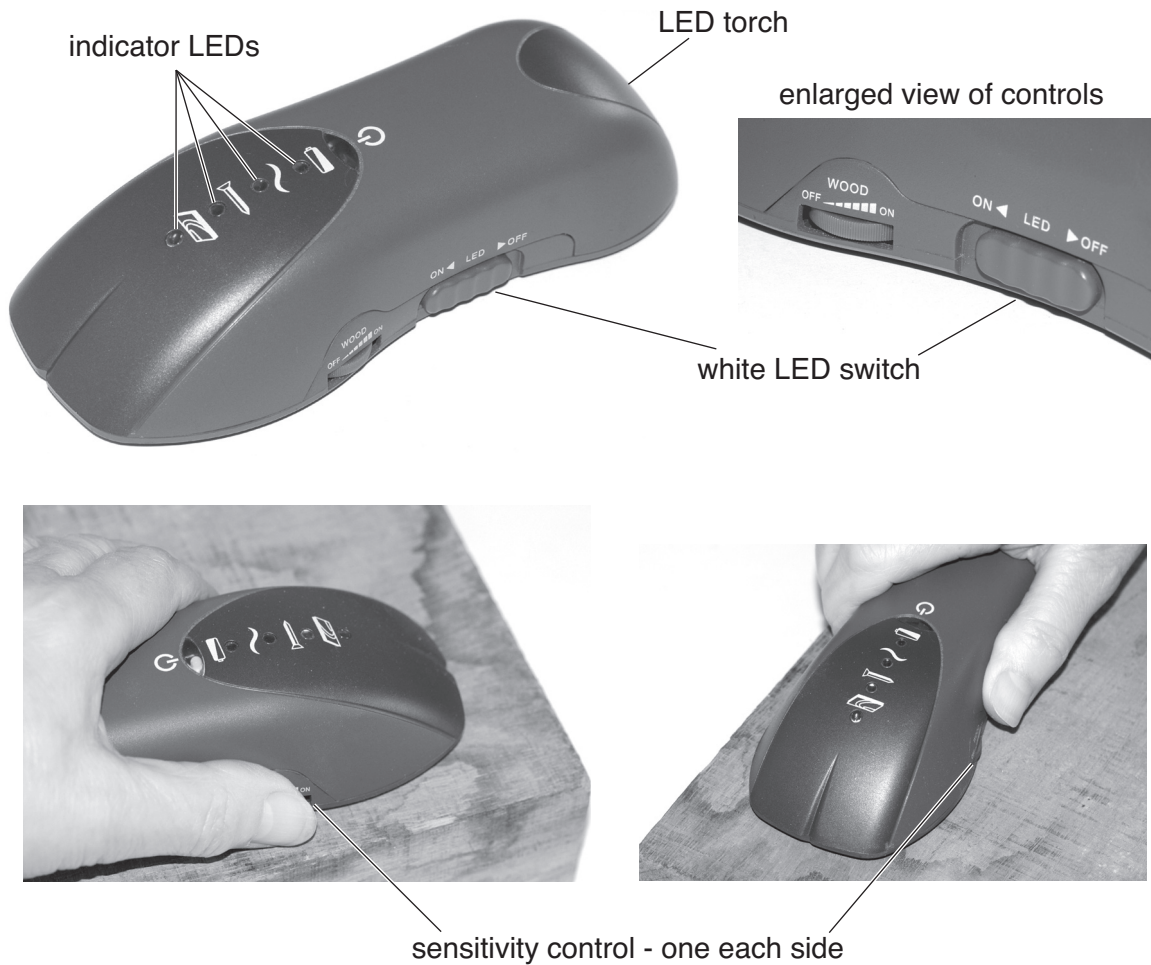


Fig. 17

(a) Give **two** factors that contribute to the ergonomic design of the detector.

- 1 [1]
- 2 [1]

- (b) The case is injection moulded with the base held in place by self tapping screws as shown in Fig. 18.



Fig. 18

- (i) Give **one** reason for using self tapping screws to secure the base during manufacture.

.....
 [1]

- (ii) State why the symbols next to the indicator LEDs and controls in Fig. 17 must have been applied after the moulding had taken place.

.....
 [1]

- (c) Fig. 19 shows a view of the circuit board.

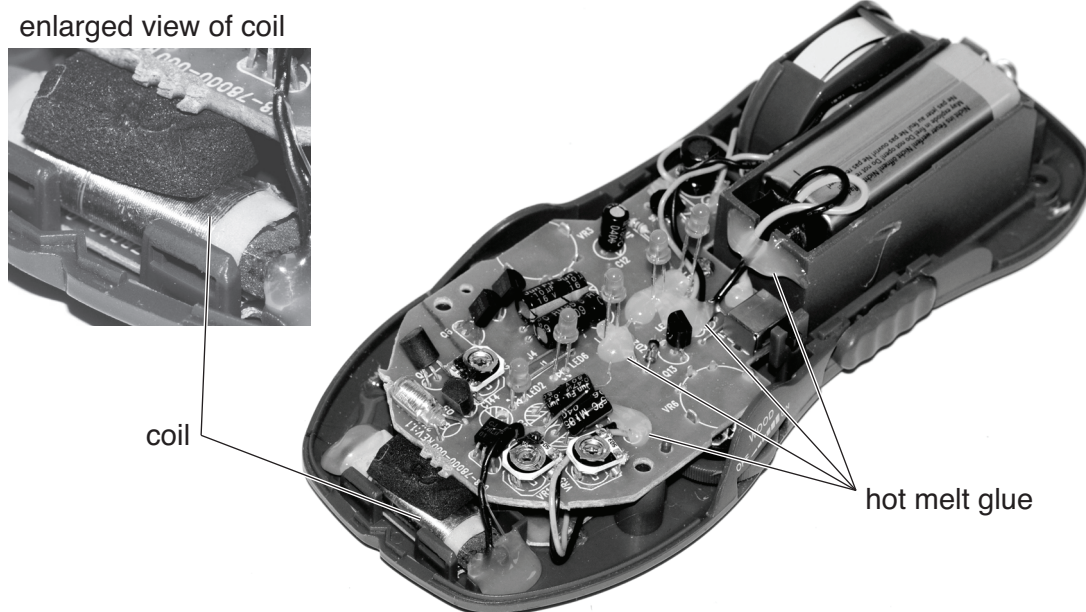


Fig. 19

- (i) Give **one** reason for connecting wires being held in place with hot melt glue.

..... [1]

- (ii) The sensor for the detector uses enamelled copper wire in a coil.
 State **one** reason for the use of enamel on the copper wire.

.....
 [1]

- (d) Fig. 20 shows the LED indicators on the circuit board. The LEDs have been soldered into position at varying heights to match the curve of the case.

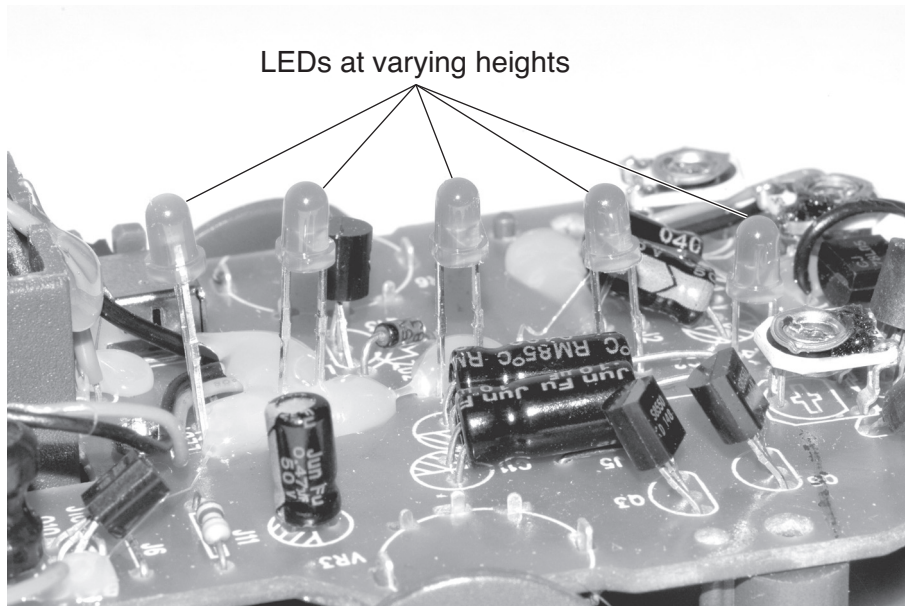


Fig. 20

- (i) Use notes or sketches to describe how the LED heights could be accurately controlled when assembling a batch of boards.

- (ii) Fig. 21 shows two radial capacitors on the circuit board, bent to a horizontal position.

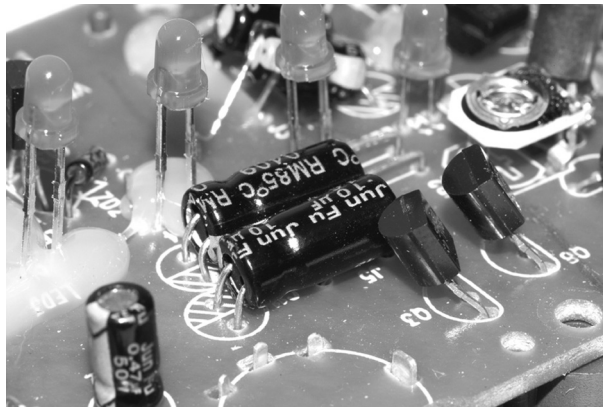


Fig. 21

Explain why it may be better to use either shorter radial capacitors or axial capacitors.

.....

.....

..... [2]

[Total: 10]

14
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