FOR OFFICIAL USE

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N5

National Qualifications 2026

Mark

# X860/75/02 Practical Electronics

THURSDAY, 7 MAY

1:30 PM – 2:30 PM

*X8607502*

**Fill in these boxes and read what is printed below.**

Full name of centre

Town

Forename(s)

Surname

Number of seat

Date of birth

Day | Month | Year

Scottish candidate number

**Total marks — 60**

Attempt ALL questions.

**You may use a calculator.**

Write your answers clearly in the spaces provided in this booklet. Additional space for answers is provided at the end of this booklet. If you use this space you must clearly identify the question number you are attempting.

Use **blue** or **black** ink.

Do not remove any exam materials. You must leave this booklet on your desk; if you do not, you could lose all the marks for this paper.

*X860750201*

Qualifications Scotland
Teisteanasan Alba


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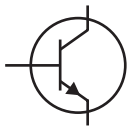
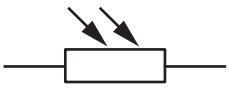
**Total marks — 60**

**Attempt ALL questions**

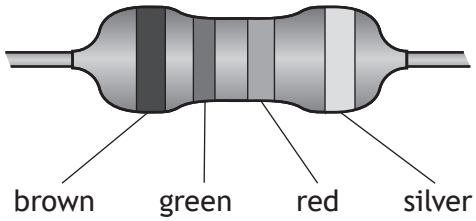
**1.** The table below gives information about some circuit components.
Some of the boxes have been left blank.

(a) Complete the table for the missing entries. **3**

| Component name | Symbol | Function |
|---|---|---|
| Bipolar transistor |  | electronic switch |
| | | controls the current in a circuit |
| Ammeter | | measures current in a circuit |
| Light dependent resistor (LDR) |  | |

**1. (continued)**

(b) The diagram below shows the colour coding for a resistor.




Using information from the data sheet, answer the questions below.

(i) Determine the resistance of the resistor. **1**

(ii) State the percentage tolerance of this resistor. **1**

(iii) Determine the maximum and minimum resistance of this resistor in ohms. **2**

**[Turn over**

**1. (continued)**

(c) The table below shows possible values for the resistance of a resistor in different notations.

| | |
|---|---|
| 220 R | 22 |
| 2.2 mΩ | 2M2 |

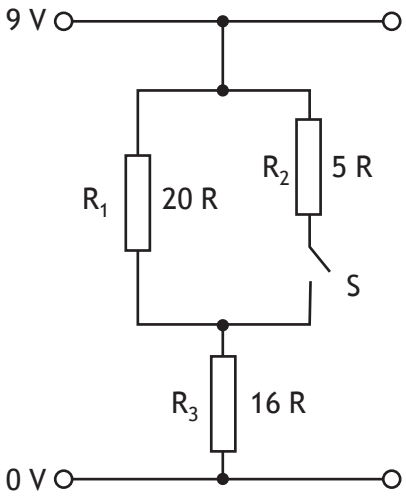
Identify which of the values shown is the **largest** value of resistance. **1**

MARKS | DO NOT WRITE IN THIS MARGIN

**2.** State two safety precautions that must be taken when using a soldering iron. **2**

**[Turn over**

**3.** A circuit diagram is shown below.




(a) Switch S is **open**.

(i) Calculate the total resistance of this circuit. **1**

*Space for working and answer*

(ii) Calculate the current in this circuit. **3**

*Space for working and answer*

**3. (a) (continued)**

(iii) Calculate the power dissipated in resistor $R_3$. **3**

*Space for working and answer*

(b) Switch S is now **closed**.

(i) Calculate the effective resistance of the two resistors in parallel. **3**

*Space for working and answer*

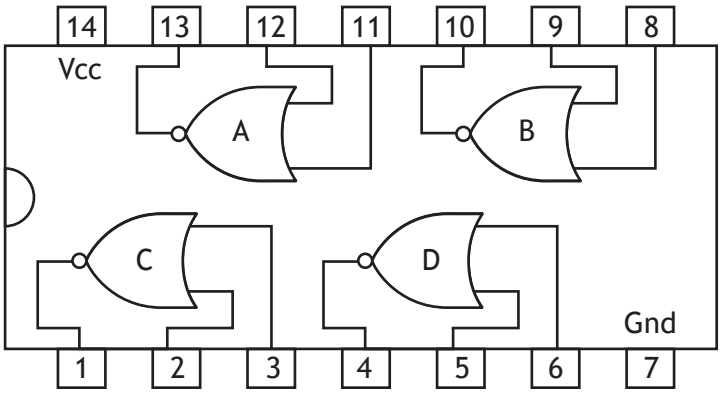
(ii) Calculate the overall circuit resistance. **1**

*Space for working and answer*

**[Turn over**

**4.** Logic gates are widely used in electronic circuits.

(a) A pinout for a 74 series logic chip is shown below.




(i) Using information from the data sheet, identify the **integrated circuit** (IC) shown. **1**

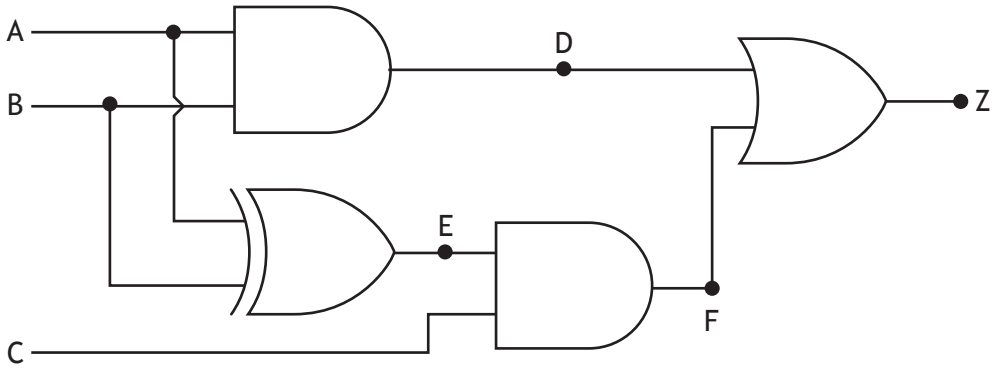
(ii) Identify an **output** pin on the integrated layout diagram above. **1**

(iii) With reference to logic gate **A**, on the above pinout diagram, pins 12 and 13 have a logic state of 0.

State the logic state at pin 11. **1**

**4. (continued)**

(b) Complete the truth table for the logic circuit shown below. **4**




| A | B | C | D | E | F | Z |
|---|---|---|---|---|---|---|
| 0 | 0 | 0 | | | | |
| 0 | 0 | 1 | | | | |
| 0 | 1 | 0 | | | | |
| 0 | 1 | 1 | | | | |
| 1 | 0 | 0 | | | | |
| 1 | 0 | 1 | | | | |
| 1 | 1 | 0 | | | | |
| 1 | 1 | 1 | | | | |

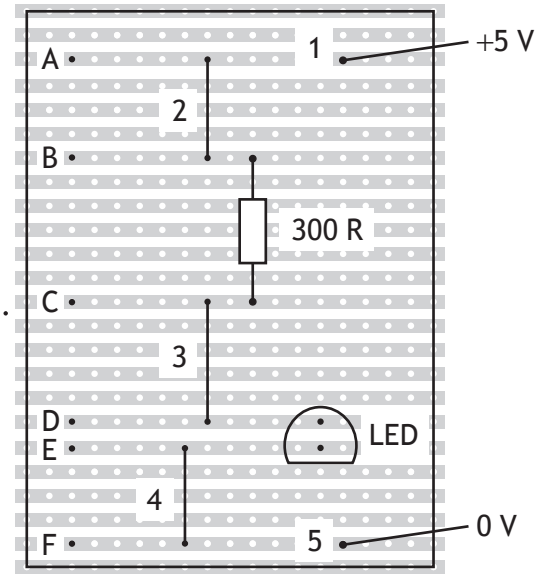
(An additional truth table, if required, can be found on *page 20*.)

**[Turn over**

**5.** (a) State an advantage of colour coding wires. **1**

(b) A student plans a stripboard layout of an LED in series with a resistor.

The layout, shown below, includes wires and test points. The wires are labelled one to five. The test points are marked A to F.




(i) The layout includes wires of different insulation colours: red, blue and black.

Identify the wire number that should have blue insulation. **1**

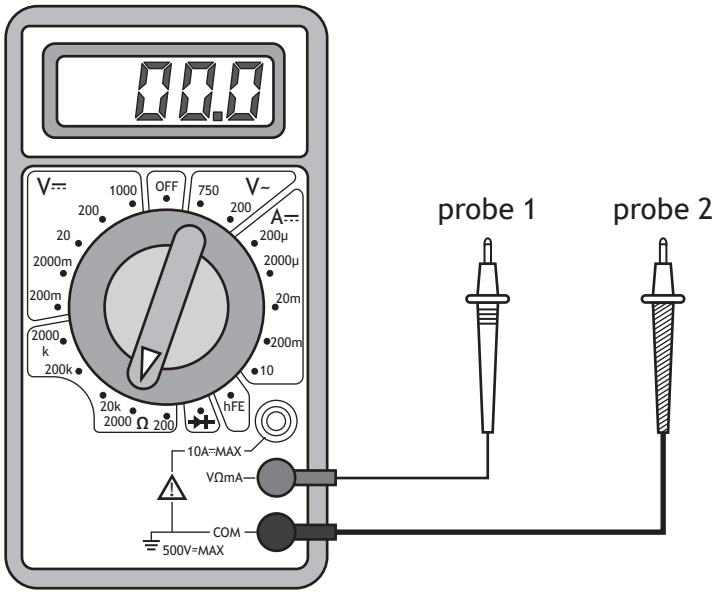
**5. (b) (continued)**

(ii) Explain the purpose of the resistor in the circuit. **1**

(iii) The student now constructs the circuit from part (b).

Before connecting the stripboard to the supply, the student tests for continuity using a multimeter.

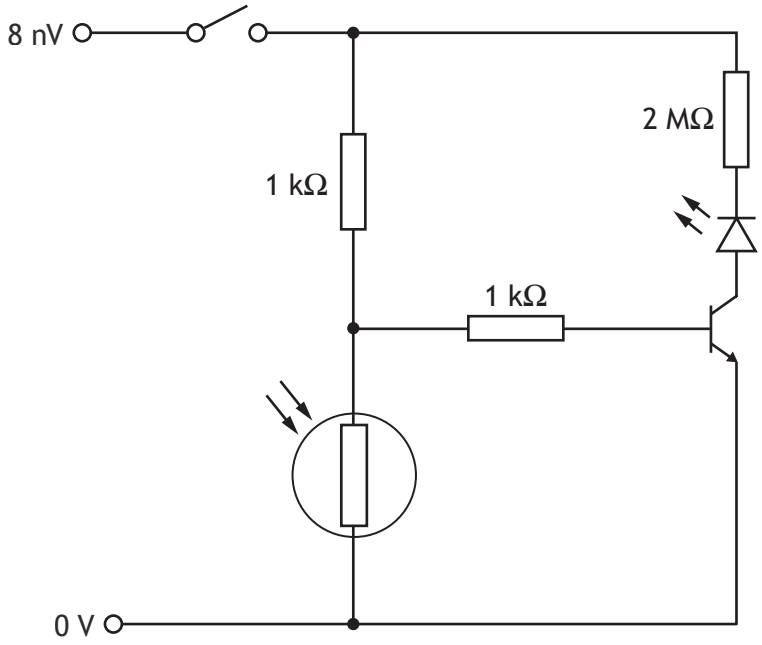
The multimeter used is shown below and will sound a 'beep' to indicate continuity.




Describe how the above multimeter can be used to test for continuity between the LED and 0 V rail line on the student's stripboard. **3**

**[Turn over**

**6.** A student simulated the circuit shown.



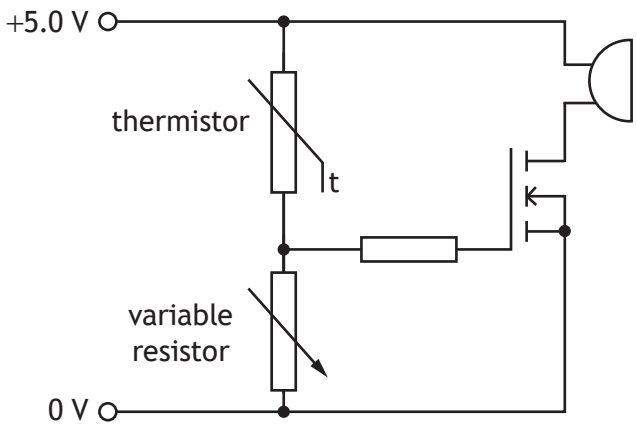

Identify three errors in this simulation. **3**

Error 1:

Error 2:

Error 3:

**7.** An alarm circuit has a buzzer that sounds when the temperature is too high.
The circuit diagram for the buzzer system is shown below.



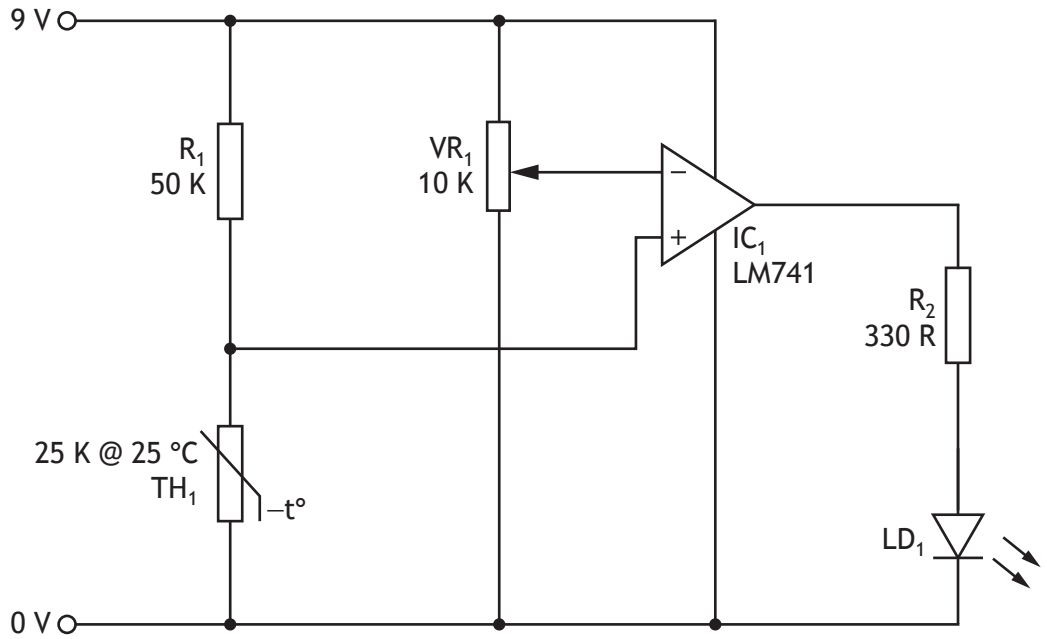

(a) At a certain temperature, the thermistor has a resistance of 1000 Ω.
The variable resistor is set at a resistance of 1500 Ω.
Calculate the voltage across the variable resistor. **3**
*Space for working and answer*

(b) Explain how the circuit operates to sound the buzzer. **3**

(c) State the purpose of the variable resistor in this circuit. **1**

**[Turn over**

**8.** A student builds the circuit shown.




Using the information from the two suppliers' catalogues shown on the opposite page, complete the costings sheet below to produce the **lowest** cost for the circuit. **5**

| Supplier | Component | Product code | Cost (p) |
|---|---|---|---|
| JIMSON | LM741CN | TC 133 | 56 |
| SWIFT | 8 way DIL | SK-0080 | 10 |
| | LED 5 mm std | | |
| | 330 R | | |
| | 50 K | | |
| | 10 K potentiometer | | |
| | thermistor | | |

(An additional costings sheet, if required, can be found on *page 20*.)

**8. (continued)**

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| Supplier — SWIFT | | | | |
|---|---|---|---|---|
| | **Component** | **Description** | **Product code** | **Cost** |
| | | | | |
| Integrated circuits | LM741CN | op-amp | IC-0258 | 75 p |
| | UA741CP | op-amp | IC-0267 | 41 p |
| | OP070CP | op-amp | IC-0234 | 110 p |
| | 8 way DIL | IC socket | SK-0080 | 10 p |
| | | | | |
| Semi-conductors | LED | 5 mm std red | SC-0155 | 4 p |
| | LED | 10 mm std red | SC-0177 | 10 p |
| | | | | |
| Thermistor | thermistor | 5 K @ 25 °C | BB-0545 | 65 p |
| | thermistor | 10 K @ 25 °C | BB-0556 | 50 p |
| | thermistor | 25 K @ 25 °C | BB-0568 | 28 p |
| | | | | |
| Resistors | 50 K | 0.25 W carbon film 5% | FR-0855 | 2.8 p |
| | 4K7 | 0.25 W carbon film 5% | FR-0856 | 2 p |
| | 330 R | 0.25 W carbon film 5% | FR-0857 | 1.5 p |
| | | | | |
| Potentiometer | 25 K | 0.5 W trimmer | PT-0765 | 95 p |
| | 10 K | 0.5 W trimmer | PT-0744 | 55 p |
| | 1 M | 0.5 W trimmer | PT-0732 | 35 p |
| | | | | |
| | | | | |
| **Supplier — JIMSON** | | | | |
| | **Component** | **Description** | **Product code** | **Cost** |
| | | | | |
| Integrated circuits | LM741CN | op-amp | TC 133 | 56 p |
| | UA741CP | op-amp | TC 134 | 36 p |
| | OP070CP | op-amp | TC 135 | 105 p |
| | 8 way DIL | IC socket | SK 090 | 30 p |
| | | | | |
| Semi-conductors | LED | 5 mm std red | LD 345 | 12 p |
| | LED | 10 mm std red | LD 346 | 25 p |
| | | | | |
| Thermistor | thermistor | 5 K @ 25 °C | TH 114 | 32 p |
| | thermistor | 10 K @ 25 °C | TH 115 | 45 p |
| | thermistor | 25 K @ 25 °C | TH 116 | 22 p |
| | | | | |
| Resistors | 50 K | 0.25 W carbon film 5% | CR 654 | 2.5 p |
| | 4K7 | 0.25 W carbon film 5% | CR 655 | 1.7 p |
| | 330 R | 0.25 W carbon film 5% | CR 656 | 1.2 p |
| | | | | |
| Potentiometer | 25 K | 0.5 W trimmer | VT 250 | 92 p |
| | 10 K | 0.5 W trimmer | VT 251 | 65 p |
| | 1 M | 0.5 W trimmer | VT 252 | 40 p |

**9.** An engineer designs a system to control the temperature of the water in a tropical fish tank.

The system requires an electric heater to turn on when the temperature of the water becomes too cold.

An LED should switch on when the heater is on.

There is also a manual switch to turn the whole system on and off.

Selecting from the elements given, draw a block diagram of an electronic solution for this system.

On your diagram, clearly indicate the input, process and output sections of your solution. **6**

| | | | | |
|---|---|---|---|---|
| heating element (requires a logic 1 to turn on) | NOT gate | temperature sensor (logic 0 when cold) | NOR gate | manual switch (logic 1 when closed) |
| AND gate | alarm (requires a logic 1 to turn on) | XOR gate | LED (requires a logic 1 to turn on) | light sensor (requires a logic 1 to turn on) |

**[Turn over for next question**

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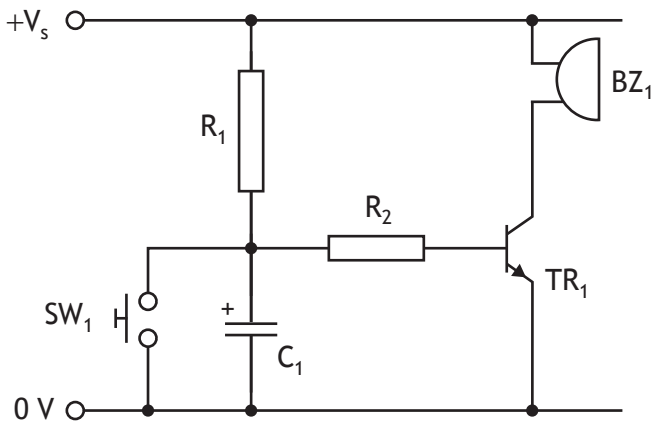
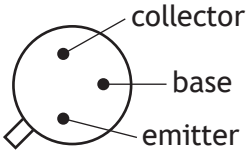
**10.** A time delay circuit is shown below.

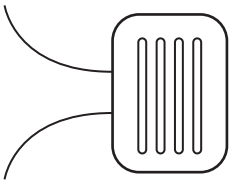



**Component data**

$R_1$ — carbon film 10 kΩ 0.25 W
$R_2$ — carbon film 1 kΩ 0.25 W
$C_1$ — 2200 mF **electrolytic** capacitor
$SW_1$ — push-to-make switch
$TR_1$ — BC108 npn bipolar
$BZ_1$ — buzzer 6 V dc
$TR_1$ pin connections




buzzer with connecting wires



electrolytic capacitor

push-to-make switch

On the opposite page, a layout diagram includes the power rails and components $TR_1$ and $R_2$.

Complete the layout diagram with the remaining components.

Each component must be identified by a label.

Mark on the layout diagram, with an X, where a track has been cut. **5**

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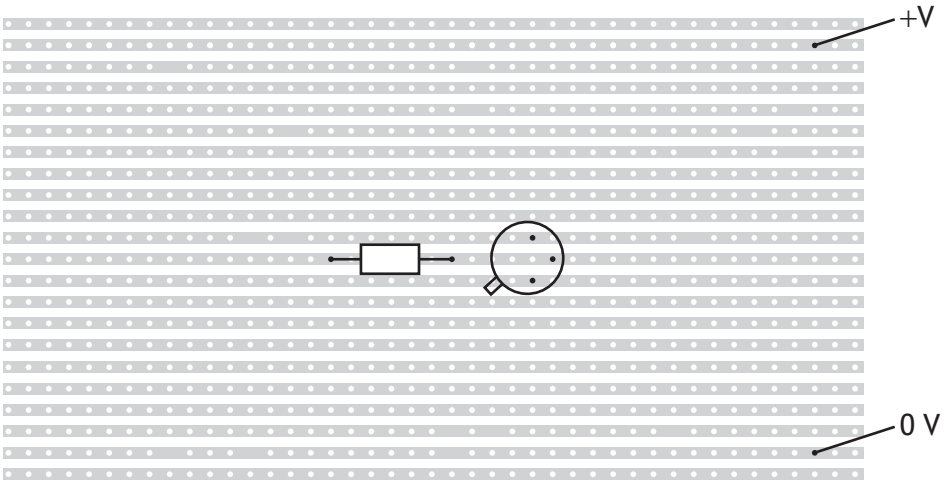
**10. (continued)**

layout diagram




(An additional layout diagram, if required, can be found on *page 21*.)

**[END OF QUESTION PAPER]**

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## ADDITIONAL SPACE FOR ANSWERS

Additional truth table for question 4 (b)

| A | B | C | D | E | F | Z |
|---|---|---|---|---|---|---|
| 0 | 0 | 0 | | | | |
| 0 | 0 | 1 | | | | |
| 0 | 1 | 0 | | | | |
| 0 | 1 | 1 | | | | |
| 1 | 0 | 0 | | | | |
| 1 | 0 | 1 | | | | |
| 1 | 1 | 0 | | | | |
| 1 | 1 | 1 | | | | |

Additional costings sheet for question 8

| Supplier | Component | Product code | Cost (p) |
|---|---|---|---|
| JIMSON | LM741CN | TC 133 | 56 |
| SWIFT | 8 way DIL | SK-0080 | 10 |
| | LED 5 mm std | | |
| | 330 R | | |
| | 50 K | | |
| | 10 K potentiometer | | |
| | thermistor | | |

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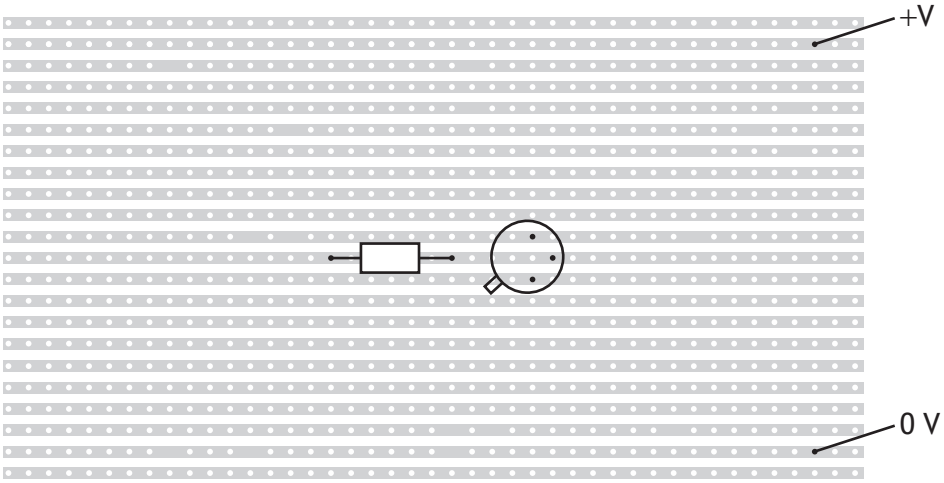
## ADDITIONAL SPACE FOR ANSWERS

Additional diagram for question 10

layout diagram



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## ADDITIONAL SPACE FOR ANSWERS

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## ADDITIONAL SPACE FOR ANSWERS

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