



**GCSE**

**4161/01**

**ELECTRONICS**

**UNIT E1: Paper replacement test**

**A.M. FRIDAY, 12 June 2015**

**1 hour plus your additional time allowance**

**Surname** \_\_\_\_\_

**Other Names** \_\_\_\_\_

**Centre Number** \_\_\_\_\_

**Candidate Number** 0 \_\_\_\_\_

<b>For Examiner's use only</b>		
<b>Question</b>	<b>Maximum Mark</b>	<b>Mark Awarded</b>
<b>1.</b>	<b>3</b>	
<b>2.</b>	<b>7</b>	
<b>3.</b>	<b>4</b>	
<b>4.</b>	<b>3</b>	
<b>5.</b>	<b>4</b>	
<b>6.</b>	<b>1</b>	
<b>7.</b>	<b>3</b>	
<b>8.</b>	<b>3</b>	
<b>9.</b>	<b>3</b>	
<b>10.</b>	<b>2</b>	
<b>11.</b>	<b>3</b>	
<b>12.</b>	<b>1</b>	
<b>13.</b>	<b>4</b>	
<b>14.</b>	<b>3</b>	
<b>15.</b>	<b>2</b>	
<b>16.</b>	<b>3</b>	
<b>17.</b>	<b>2</b>	
<b>18.</b>	<b>9</b>	
<b>Total</b>	<b>60</b>	

## **ADDITIONAL MATERIALS**

**In addition to this paper you may require a calculator and a ruler and a separate insert.**

## **INSTRUCTIONS TO CANDIDATES**

**Use black ink, black ball-point pen or your usual method.**

**Write your name, centre number and candidate number in the spaces provided on the front cover.**

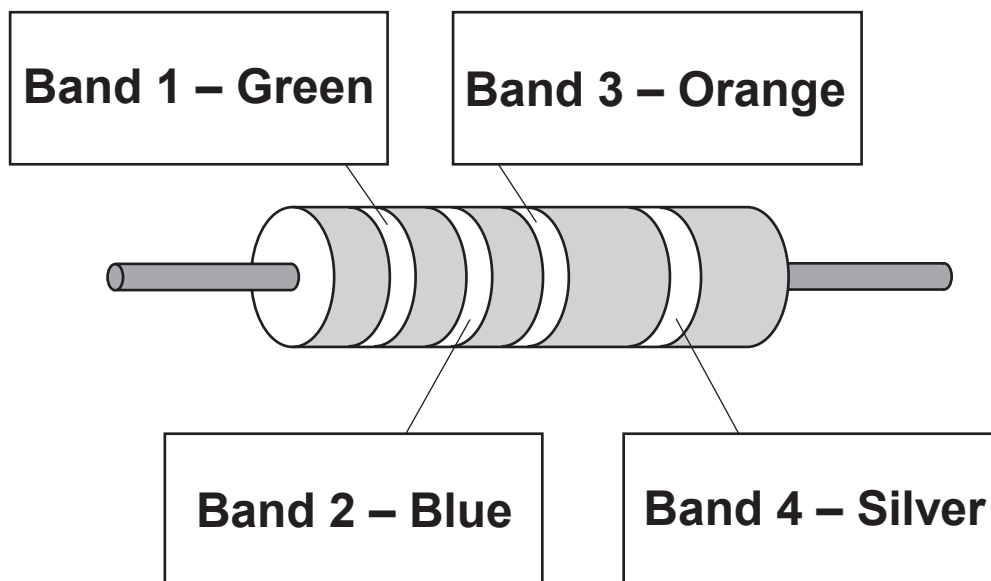
**Answer ALL questions in the spaces provided in this booklet.**

## **INFORMATION FOR CANDIDATES**

**The number of marks is given in brackets at the end of each question or part-question.**

Answer ALL questions.

1. The diagram shows a resistor.



Write down the value of this resistor in ohms.

\_\_\_\_\_  $\Omega$  [3]

2(a) Here is a list of electronic components.

LDR

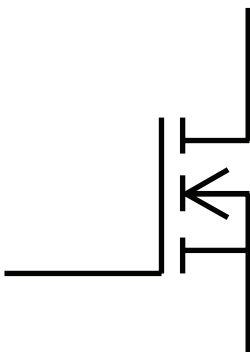
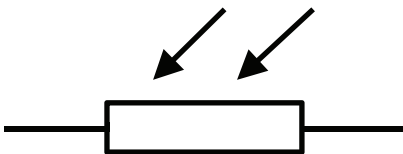
LED

MOSFET

Resistor

Transistor

Select the correct name for EACH component. [3]



## SUB-SYSTEM

## FUNCTION

Lamp unit

Transducer  
driver

AND gate

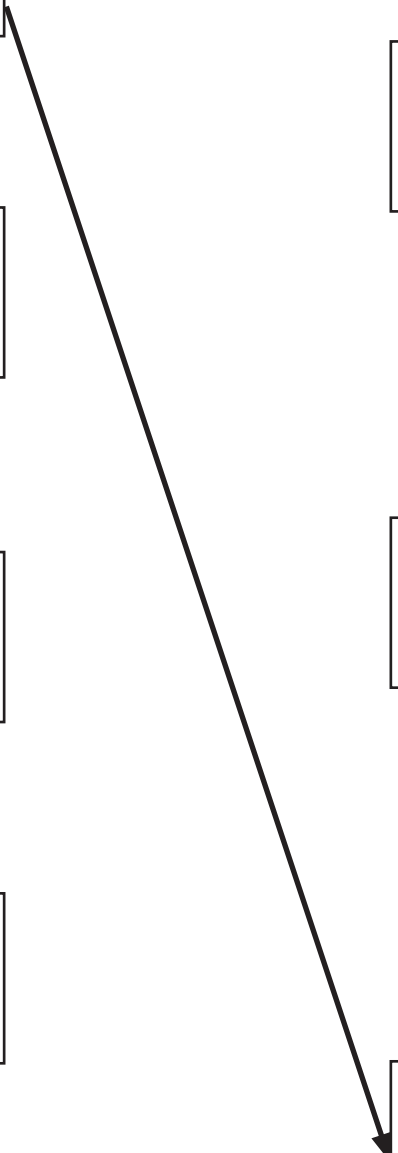
Sound sensing  
unit

Solenoid  
unit

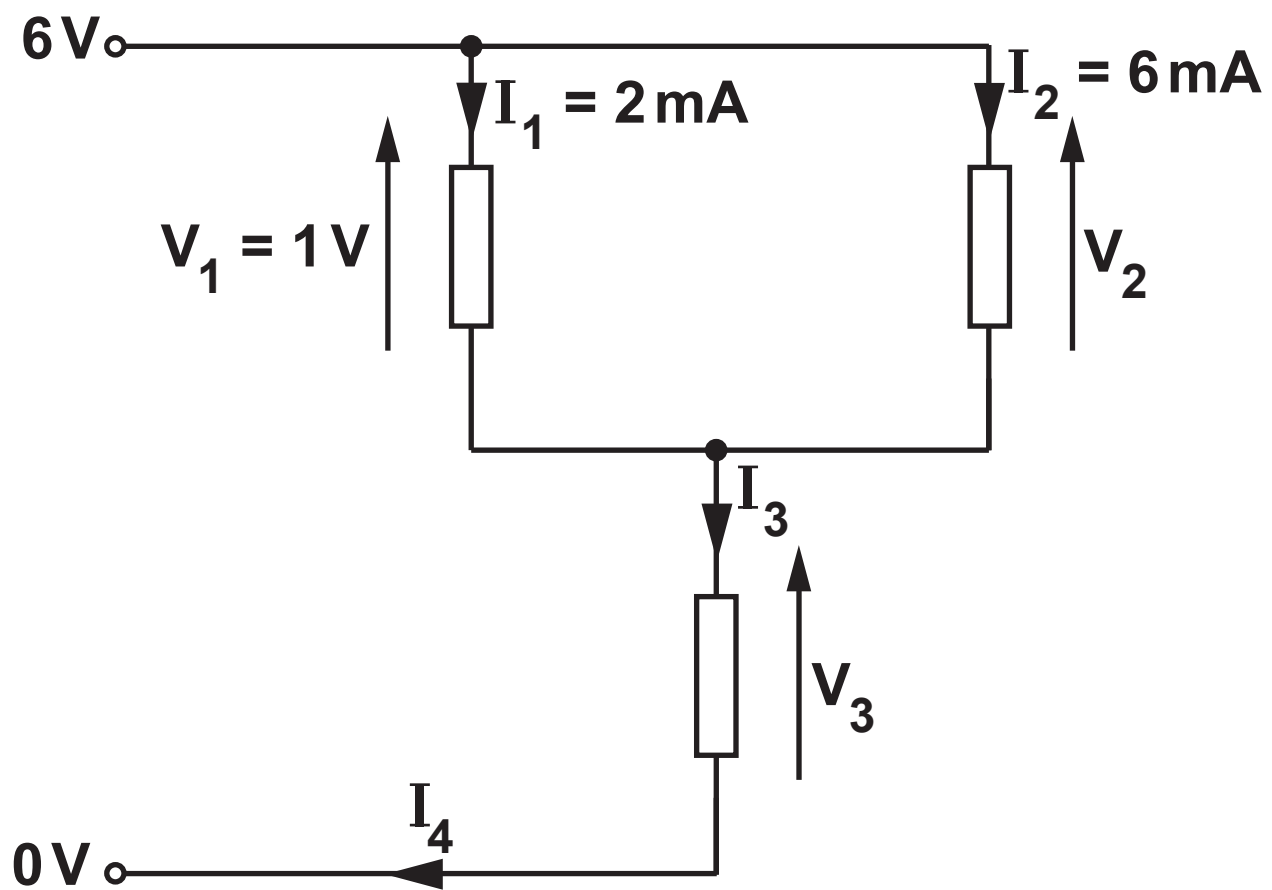
Input

Process

Output



**1(b) On the diagram opposite, link each sub-system box on the left to the correct function box on the right. One has been done for you. [4]**



3. Study the circuit opposite.

Select the correct answers to the following questions. [4]

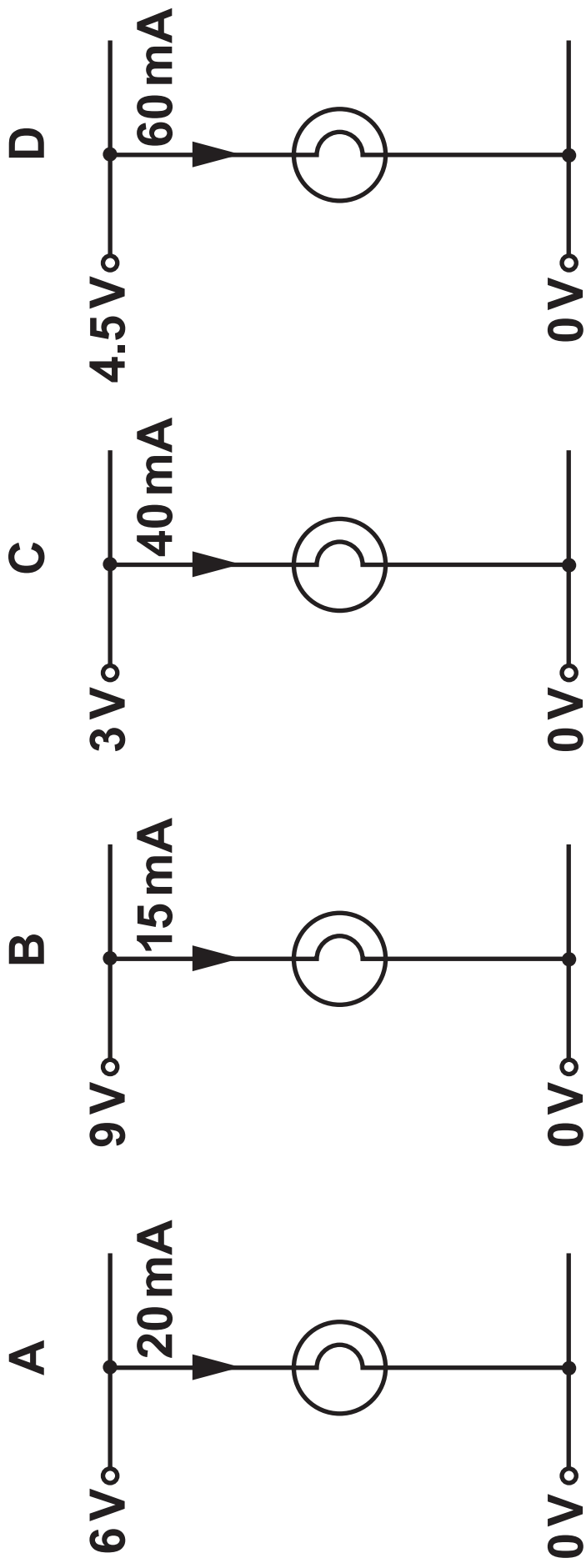
0      1      2      3      4      5      6      7      8      9

(a) What is the value of  $V_2$ ? \_\_\_\_\_ V

(b) What is the value of  $I_3$ ? \_\_\_\_\_ mA

(c) What is the value of  $V_3$ ? \_\_\_\_\_ V

(d) What is the value of  $I_4$ ? \_\_\_\_\_ mA



4. Study the diagram opposite.  
There are four lamps.

(a) (i) Tick (✓) the correct equation to calculate the power used in Lamp C in mW. [1]

$$P = 3 + 40$$

$$P = \frac{3}{40}$$

$$P = 40 + 3$$

$$P = 40 - 3$$

$$P = 3 \times 40$$

$$P = \frac{40}{3}$$

4(a) (ii) Calculate the power used in Lamp C. [1]

\_\_\_\_\_ mW

4(b) Which TWO lamps use the same power?  
(Tick (✓) the correct answer.) [1]

**A & B**

**A & C**

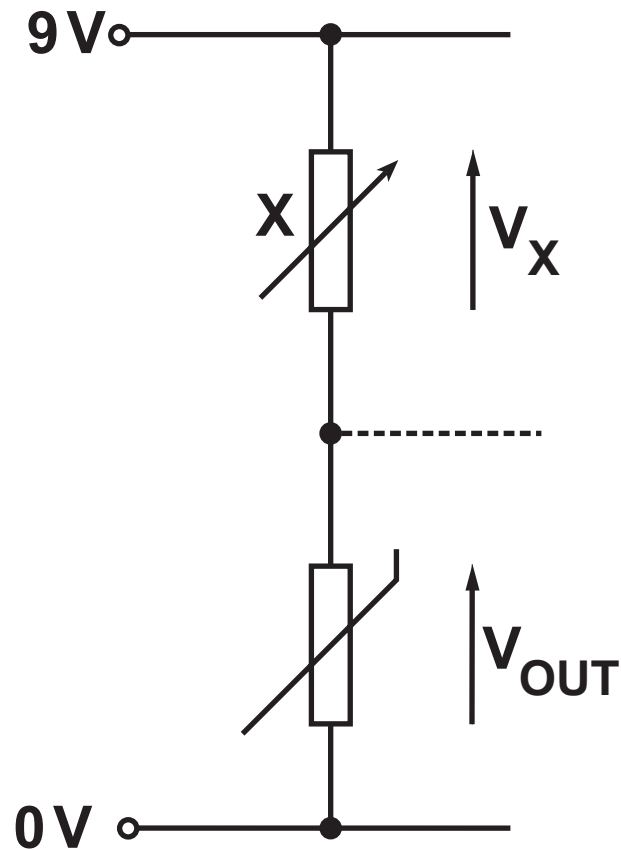
**A & D**

**B & C**

**B & D**

**C & D**

5. Here is a sensing circuit.



(a) Circle the name of the component labelled **X**. [1]

Resistor      Variable resistor      LDR      Thermistor

(b)  $V_{OUT} = 2V$ . Circle the correct voltage across component **X**. [1]

<b>0V</b>	<b>1V</b>	<b>2V</b>	<b>3V</b>	<b>4V</b>
<b>5V</b>	<b>6V</b>	<b>7V</b>	<b>8V</b>	<b>9V</b>

5(c) (i) What would happen to the voltage  $V_{OUT}$  if a torch was used to shine light on to the circuit? (Tick (✓) the correct answer.) [1]

$V_{OUT}$  would increase

$V_{OUT}$  would decrease

$V_{OUT}$  would stay the same

$V_{OUT}$  would become 0 V

(ii) Give a reason for your answer. [1]

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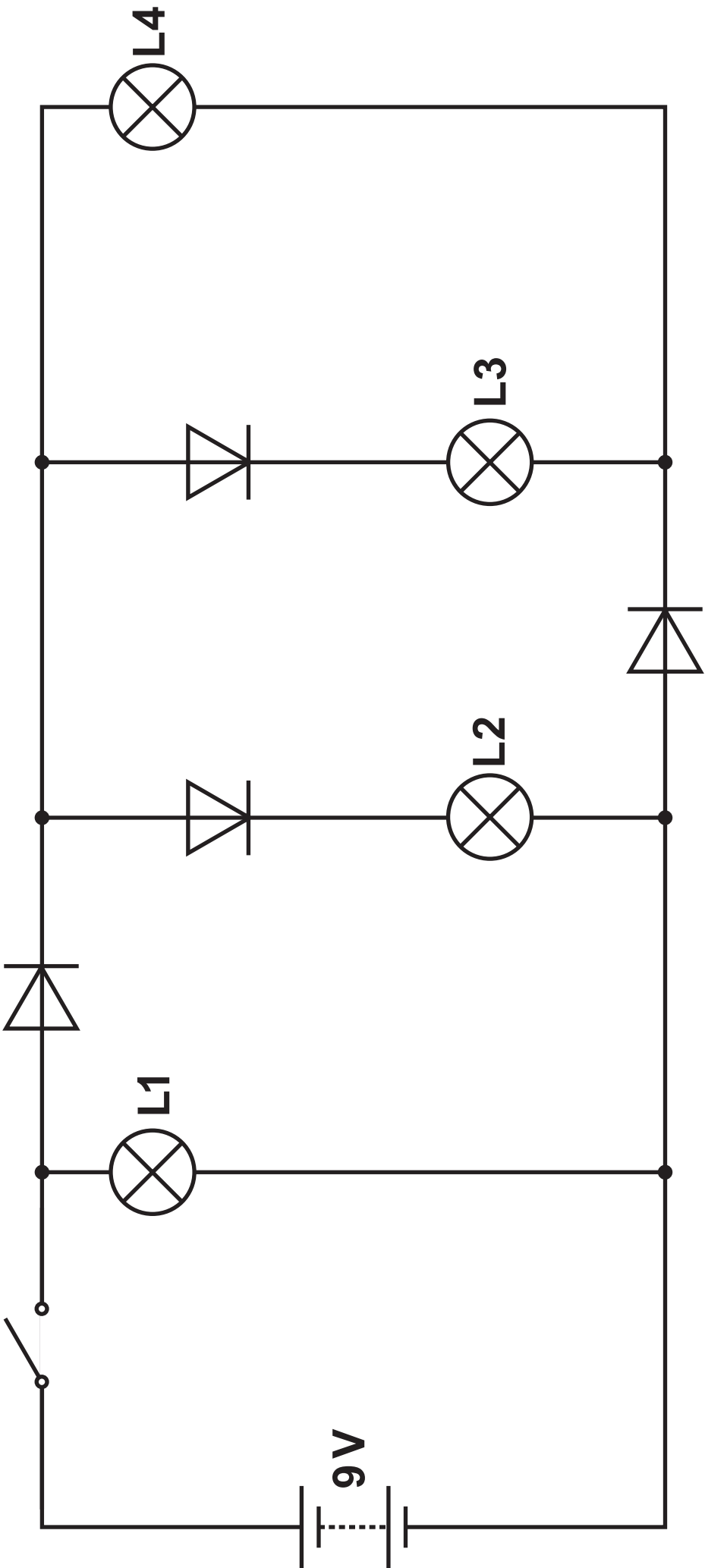
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6. The circuit opposite contains four lamps and four diodes.

Which of the following describes the correct state of the lamps when the switch is closed?

(Tick (✓) the correct answer.) [1]

All lamps off

Lamps 1 & 3 on

Lamp 1 on only

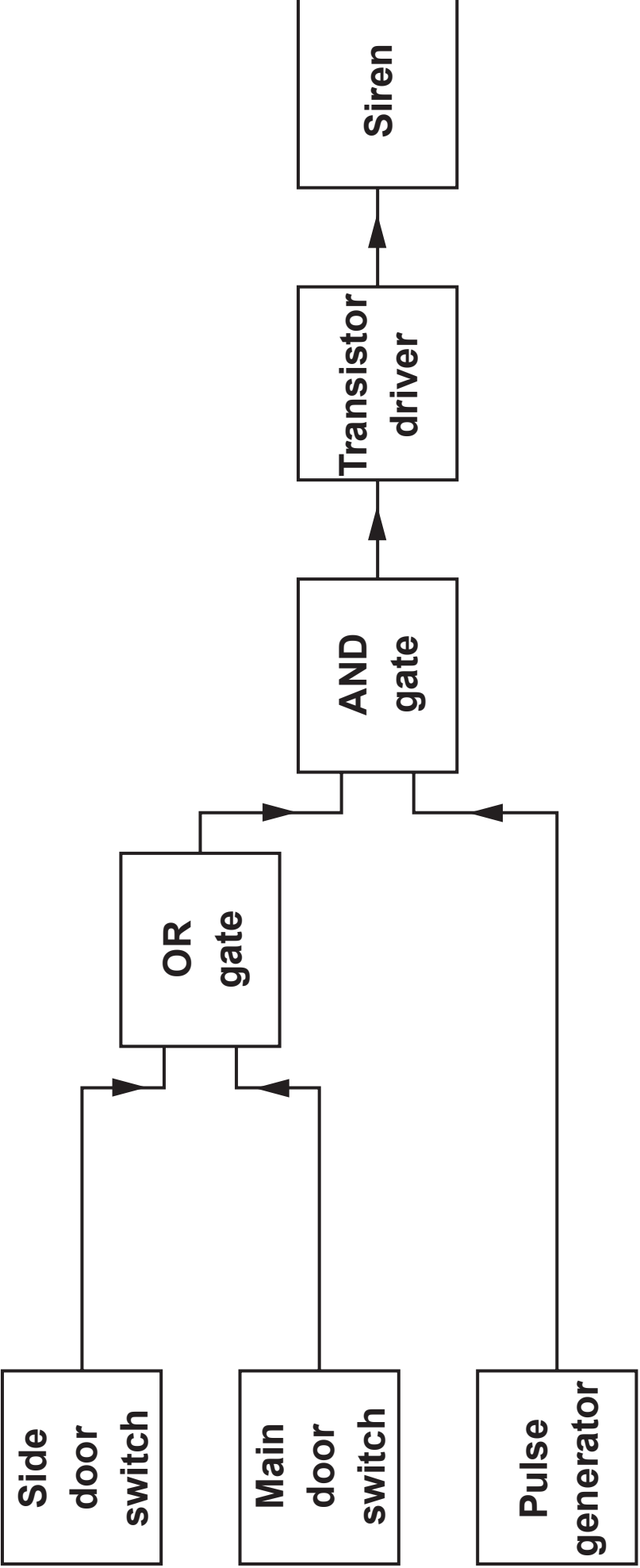
Lamps 1, 3 & 4 on

Lamps 1 & 2 on

Lamps 2 & 3 on

Lamps 1, 2 & 3 on

All lamps on



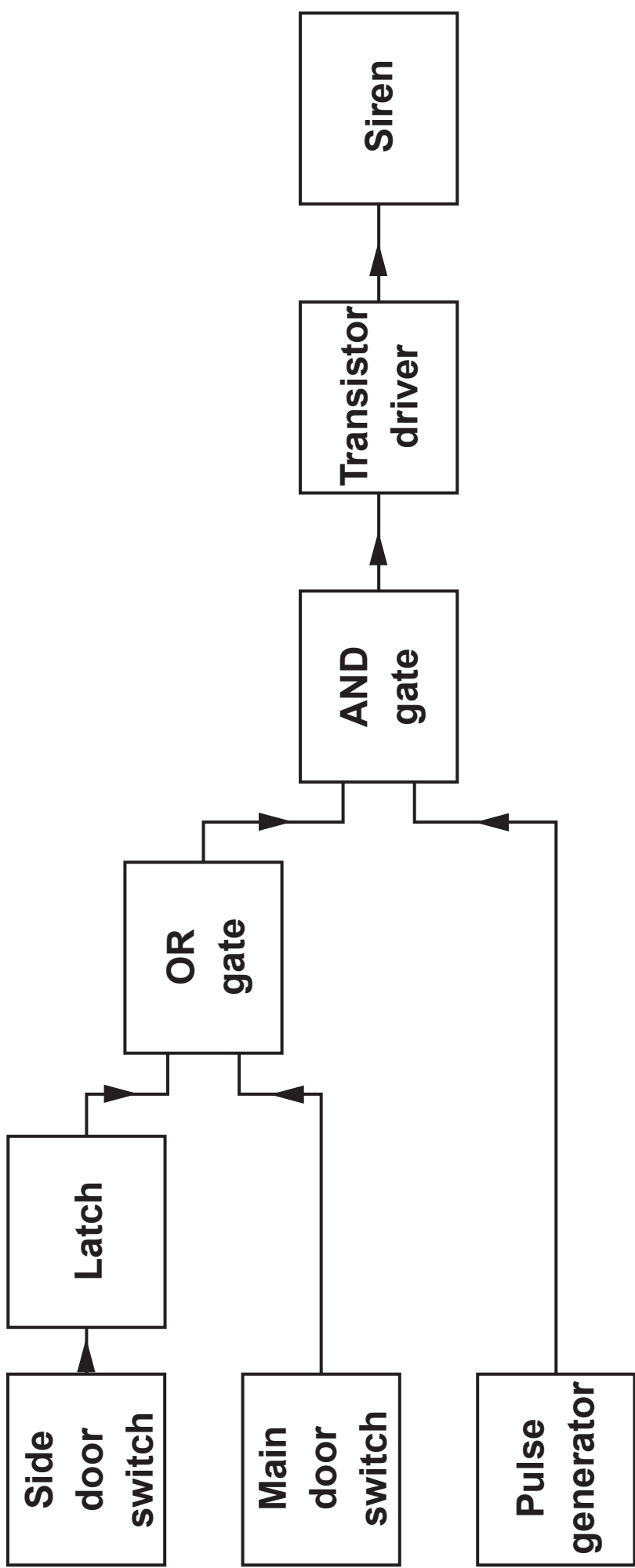
7. **Michael has designed a burglar alarm system to protect the family garage, using microswitches as inputs. Each microswitch outputs a logic 1 signal when a door is open.**

**The siren should sound when either the main garage door or the side door is opened and the siren should pulse on and off when triggered.**

**Michael proposes the design shown opposite.**

**When Michael tests the system design as shown opposite it failed to operate correctly. This was because the alarm would stop sounding when the burglar closed the door. Michael's friend Helen suggested that a latch was needed in the circuit.**

**Michael put the latch in a number of different places in the circuit.**



**7(a) Describe the effect of the latch on the operation of the circuit shown opposite. [1]**

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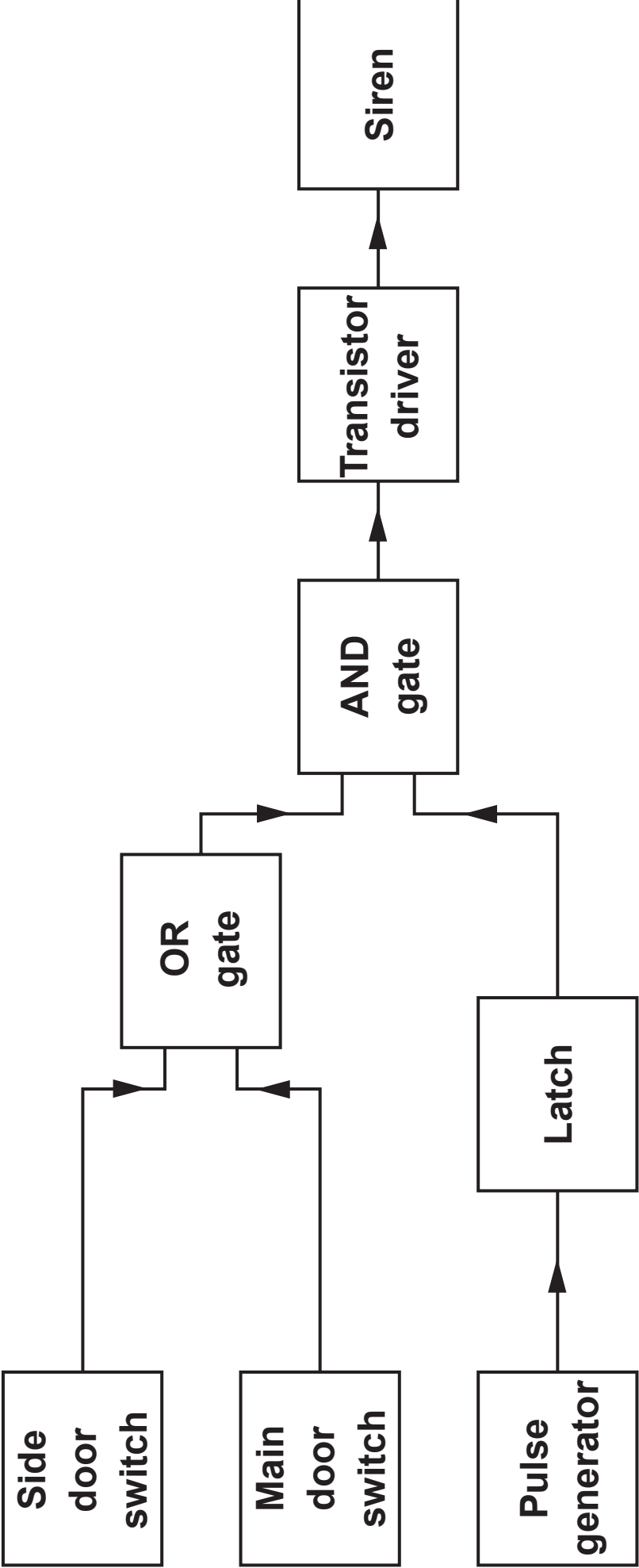
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**7(b) Describe the effect of the latch on the operation of the circuit shown opposite. [1]**

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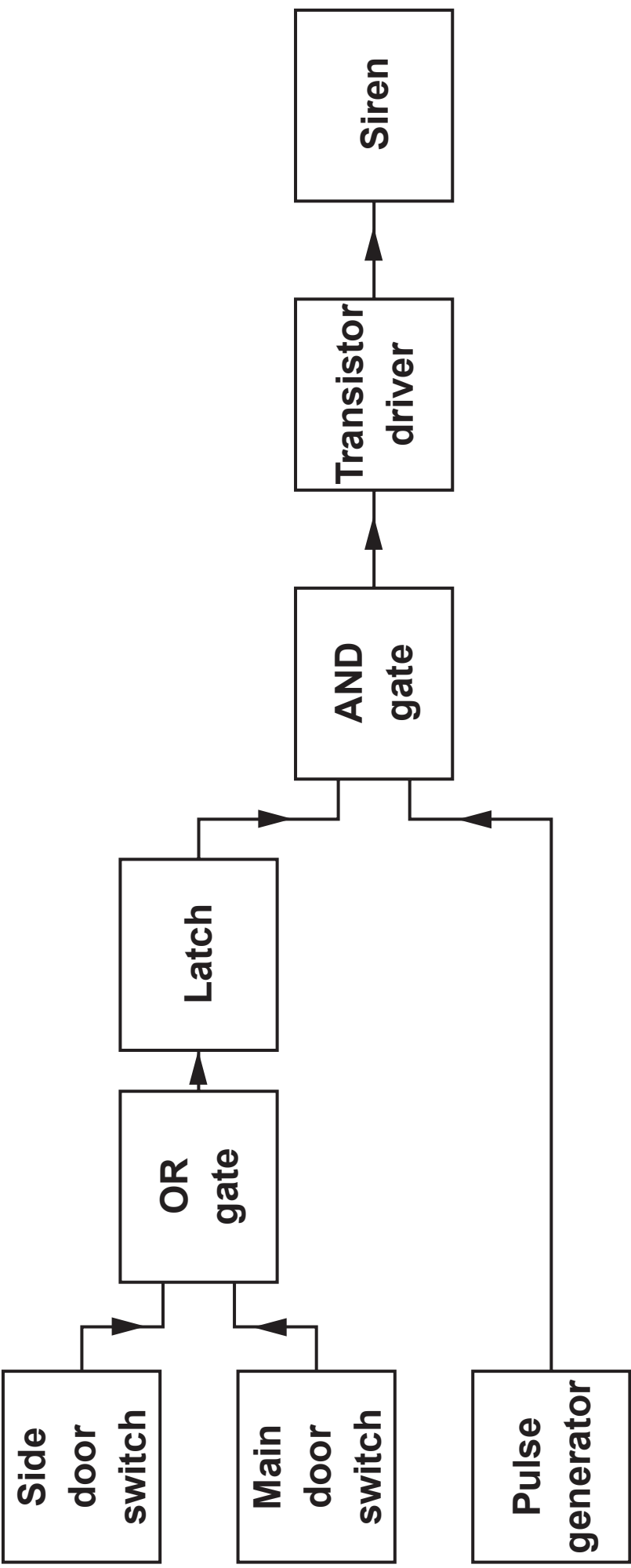
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**7(c) Describe the effect of the latch on the operation of the circuit shown opposite. [1]**

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8. Opposite is the pinout for a logic gate IC.

(a) How many logic gates are there? [1]

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(b) Circle the type of logic gate shown in the IC. [1]

AND gate

NAND gate

NOR gate

NOT gate

OR gate

(c) What is the number of the pin labelled X? [1]

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9. Here is a list of logic gates. Alongside each symbol, write the name of the logic gate. [3]

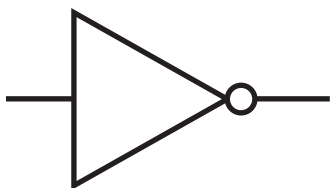
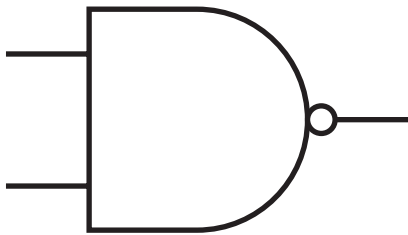
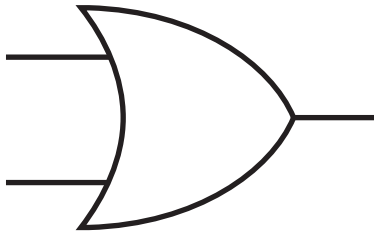
AND gate

NAND gate

NOR gate

NOT gate

OR gate



10(a) Circle the logic gate that has the following truth table. [1]

INPUTS		OUTPUT
A	B	Q
0	0	0
0	1	1
1	0	1
1	1	1

AND gate

NAND gate

NOR gate

NOT gate

OR gate

(b) Circle the logic gate that outputs a logic 1 signal ONLY when both inputs are at logic 0. [1]

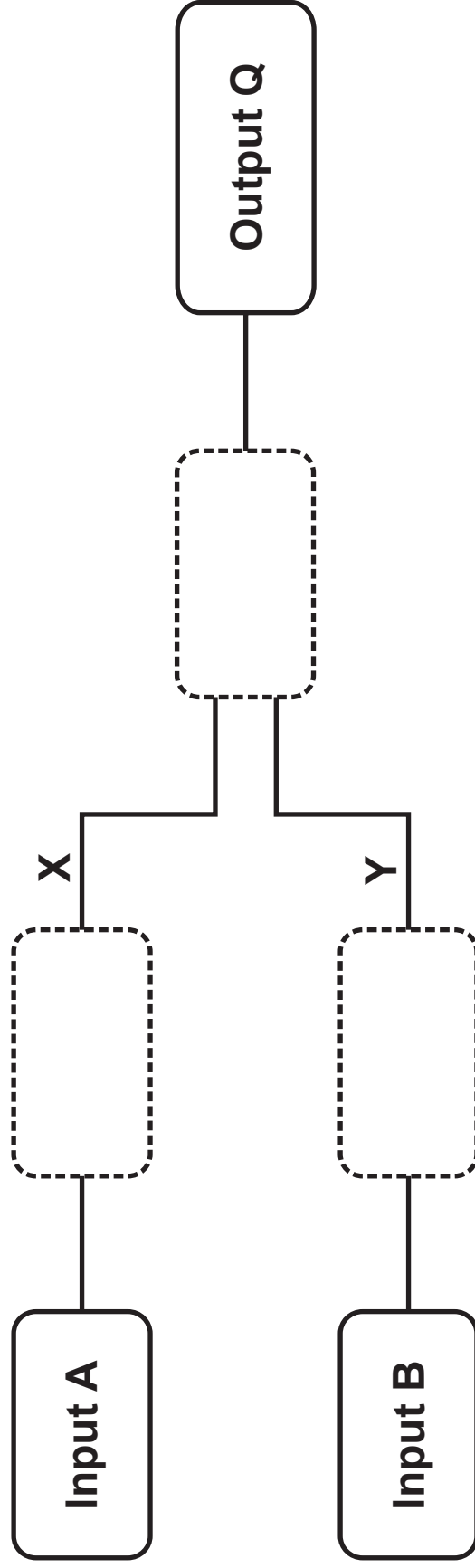
AND gate

NAND gate

NOR gate

NOT gate

OR gate

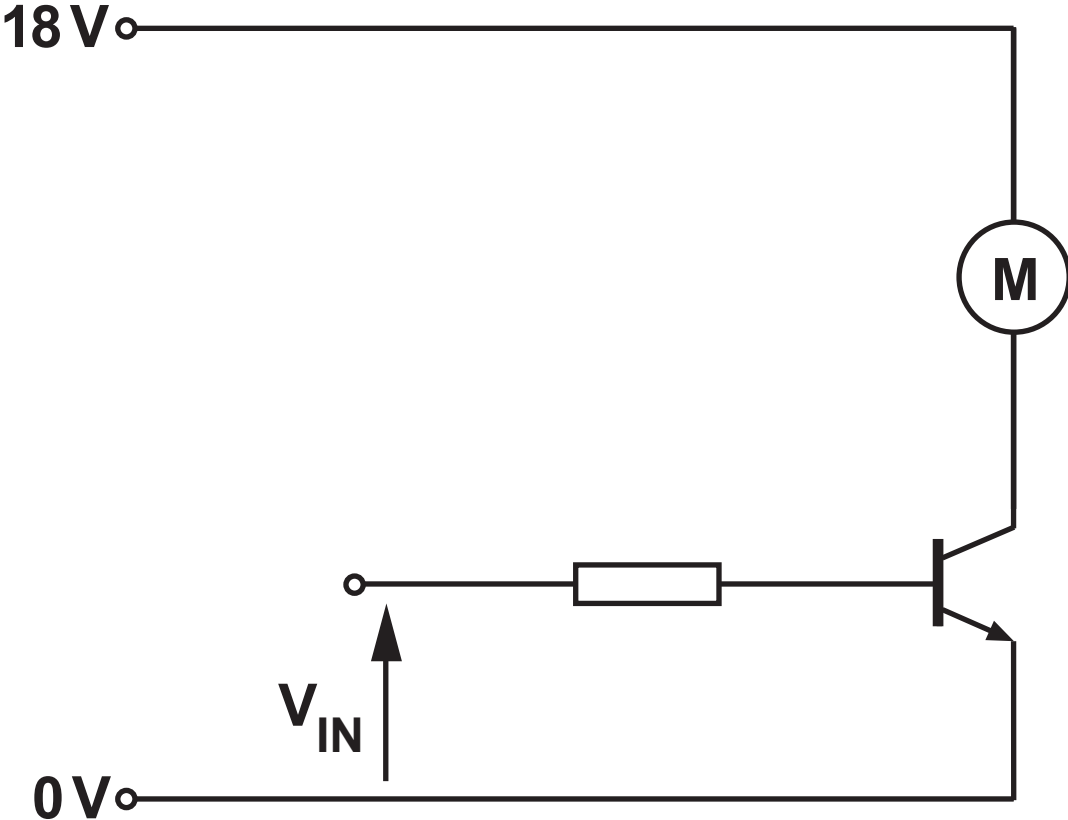


11. A logic system has the following truth table.

INPUTS		OUTPUTS		
A	B	X	Y	Q
0	0	0	1	1
0	1	0	0	0
1	0	1	1	1
1	1	1	0	1

Draw the correct logic gates / connections in the circuit opposite to produce the truth table given.

[3]

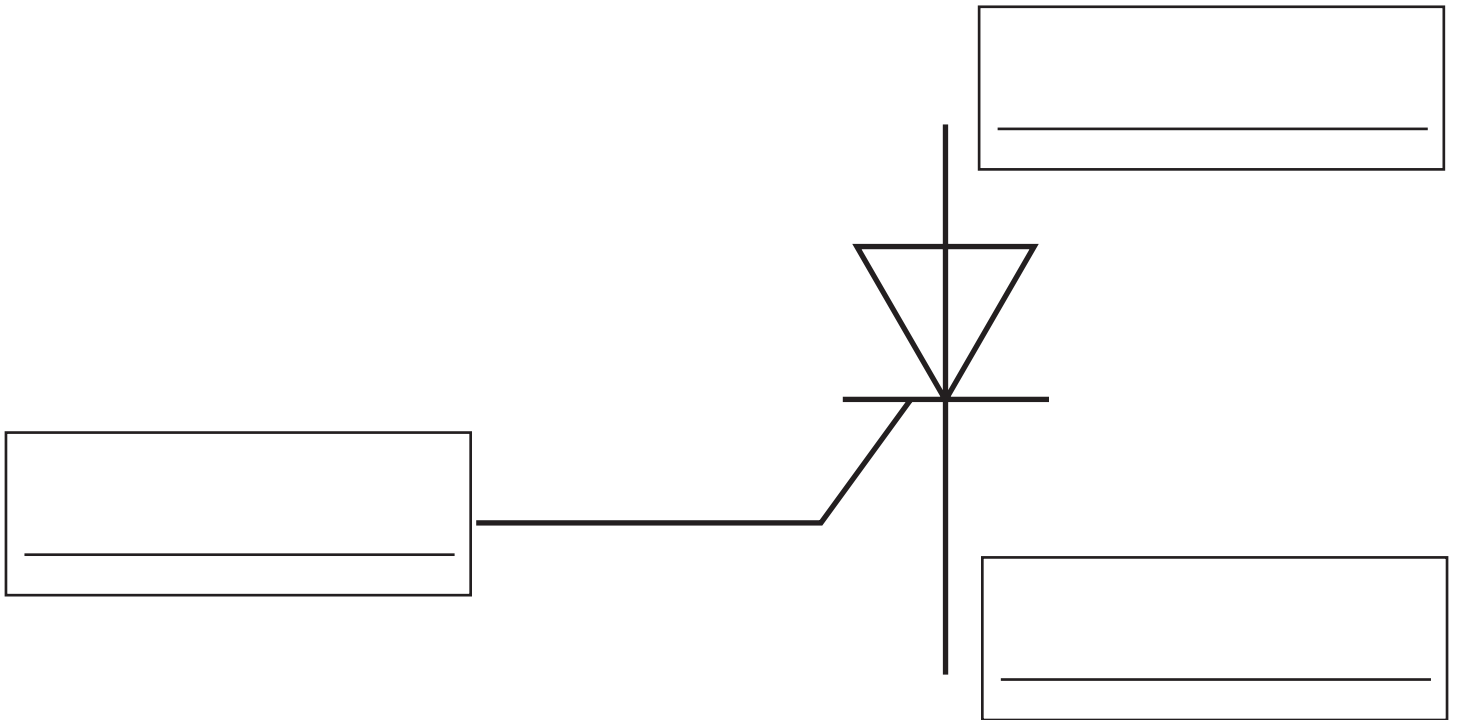


12. The circuit diagram opposite shows part of a system used to switch on a motor.

Complete the table using the word 'On' or 'Off' to show what happens to the motor for each value of  $V_{IN}$ . [1]

$V_{IN}$	MOTOR ON / OFF?
1.1 V	
2.5 V	

13. Here is a diagram for a thyristor.



Gate

Anode

Drain

Cathode

Emitter

Base

(a) Complete the diagram by adding labels. [3]

**13(b) The thyristor is capable of switching large currents as an output driver. What other property does it have that a transistor driver does not? [1]**

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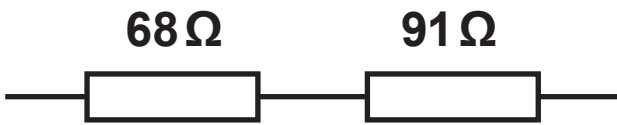
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14. The diagrams below show three different combinations of two resistors.

Calculate the effective resistance of each combination. [3]




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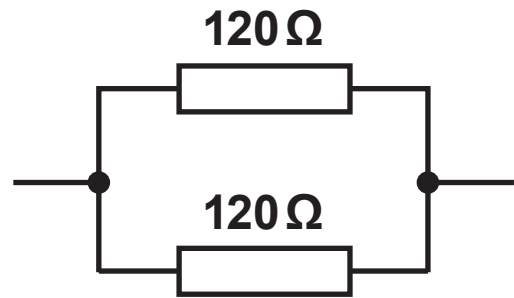


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Ω




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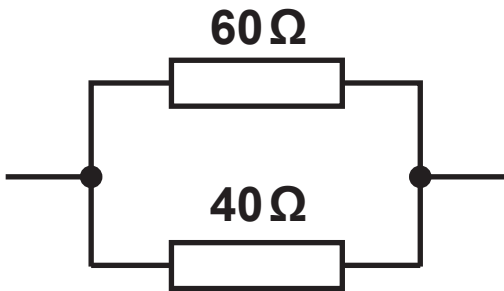


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Ω




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Ω

15. Here are two truth tables. Select the correct Boolean equation that represents the function described by each truth table. (Tick (✓) the correct answers.)

(a)

INPUTS		OUTPUT
A	B	Q
0	0	0
0	1	0
1	0	0
1	1	1

[1]

$$Q = A.B$$

$$Q = A + \bar{B}$$

$$Q = \bar{A}.\bar{B}$$

$$Q = \overline{A + B}$$

15(b)

[1]

INPUTS		OUTPUT
A	B	Q
0	0	0
0	1	0
1	0	0
1	1	1

$$Q = \bar{A}.B$$

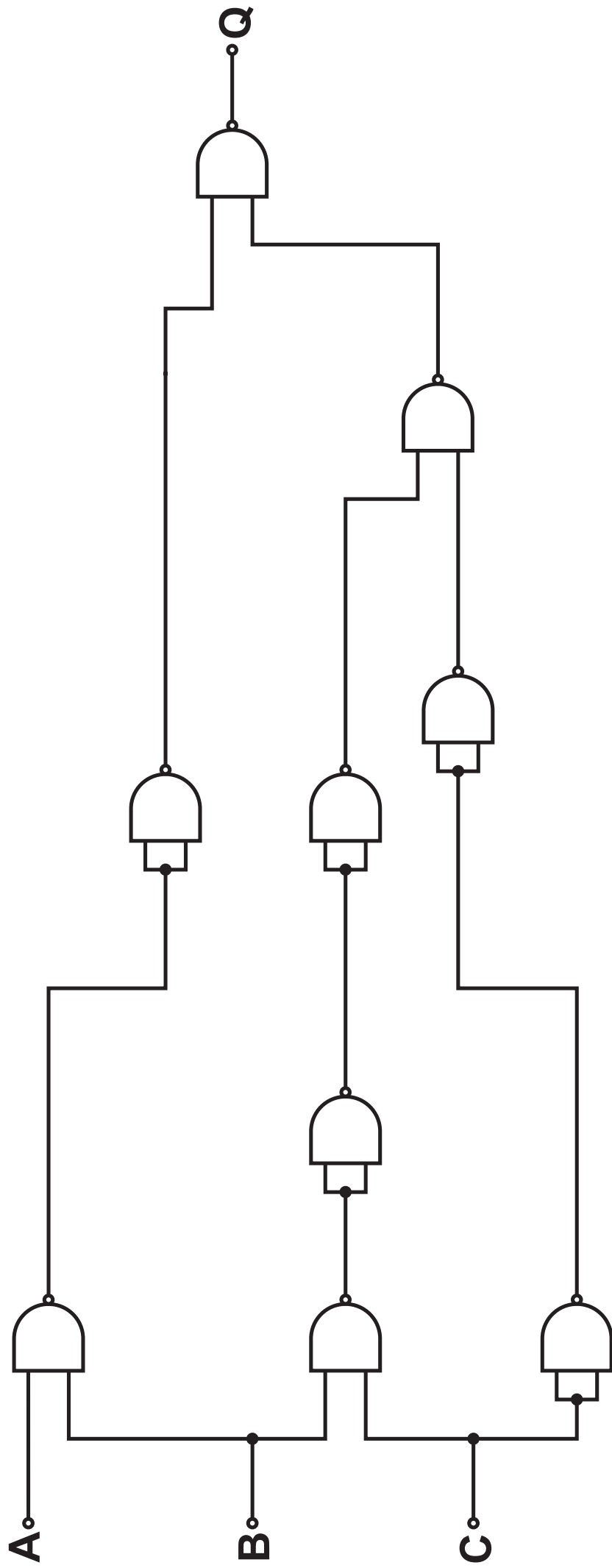
$$Q = A + B$$

$$Q = \overline{A.B}$$

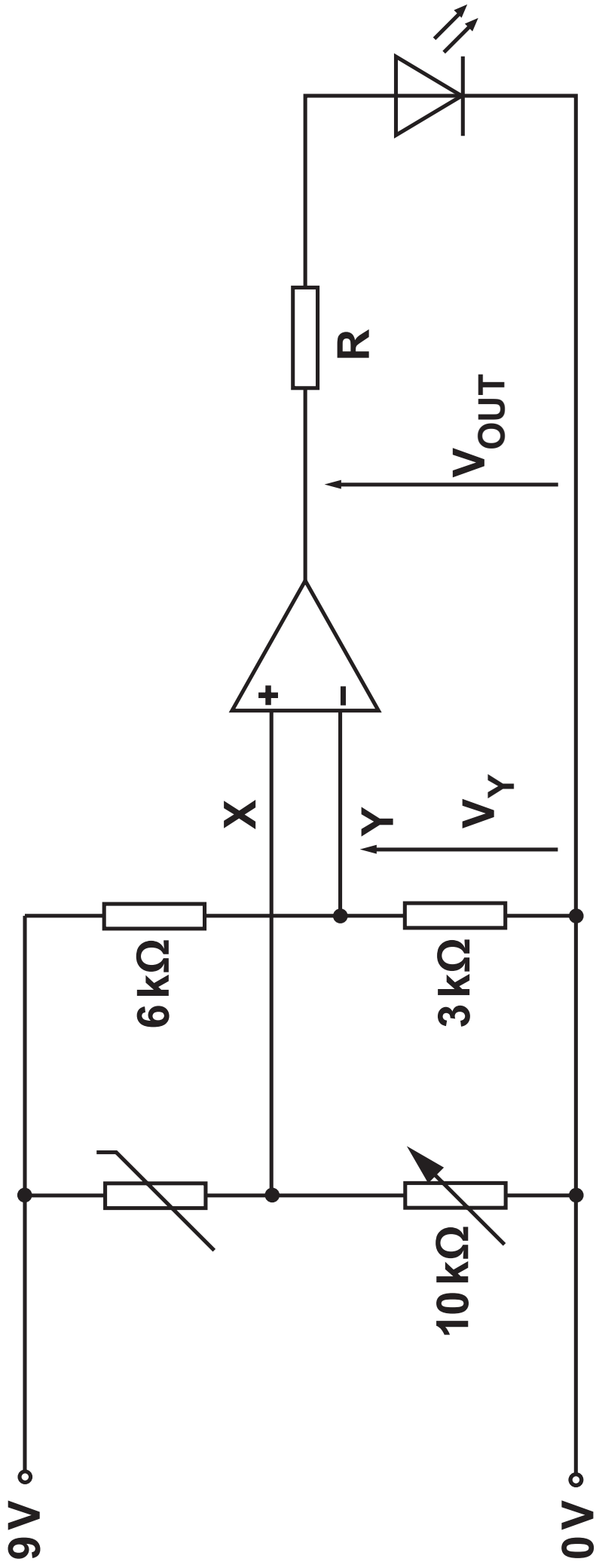
$$Q = \bar{A} + \bar{B}$$

16. Use the symbols below to complete the NAND equivalent circuits shown opposite for the logic gates.





17. Some of the NAND gates in the logic circuit opposite are redundant.  
Circle all redundant NAND gates. [2]



18. The circuit opposite shows a comparator which is used to monitor the water temperature in the radiator of a car.

(a) (i) Tick (✓) the correct equation to calculate the voltage  $V_Y$ . [1]

$$V_Y = \frac{6}{10 + 3} \times 9$$

$$V_Y = \frac{3}{10 + 6} \times 9$$

$$V_Y = \frac{3}{6 + 3} \times 9$$

$$V_Y = \frac{10}{6 + 3} \times 9$$

- 18(a) (ii) Calculate the voltage  $V_Y$  at the inverting input. [1]

$$V_Y = \text{_____} \text{ V}$$

- (b) At  $95^\circ\text{C}$ , the voltage at 'X' is  $3.6\text{ V}$ . Use your answer to part (a) to help you decide whether the LED will light up or not. Give a reason for your answer. [2]

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18(c) What is the purpose of the  $10\text{ k}\Omega$  variable resistor? [1]

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(d) The comparator output is  $9\text{ V}$ , and the LED has a forward voltage drop of  $2\text{ V}$  when a current of  $10\text{ mA}$  flows through it. [3]

(i) What is the current flowing through resistor  $R$ ?

\_\_\_\_\_ mA

(ii) Calculate the voltage drop across the resistor  $R$ .

\_\_\_\_\_ V

(iii) Calculate the ideal resistance of resistor  $R$ .

\_\_\_\_\_  $\text{k}\Omega$

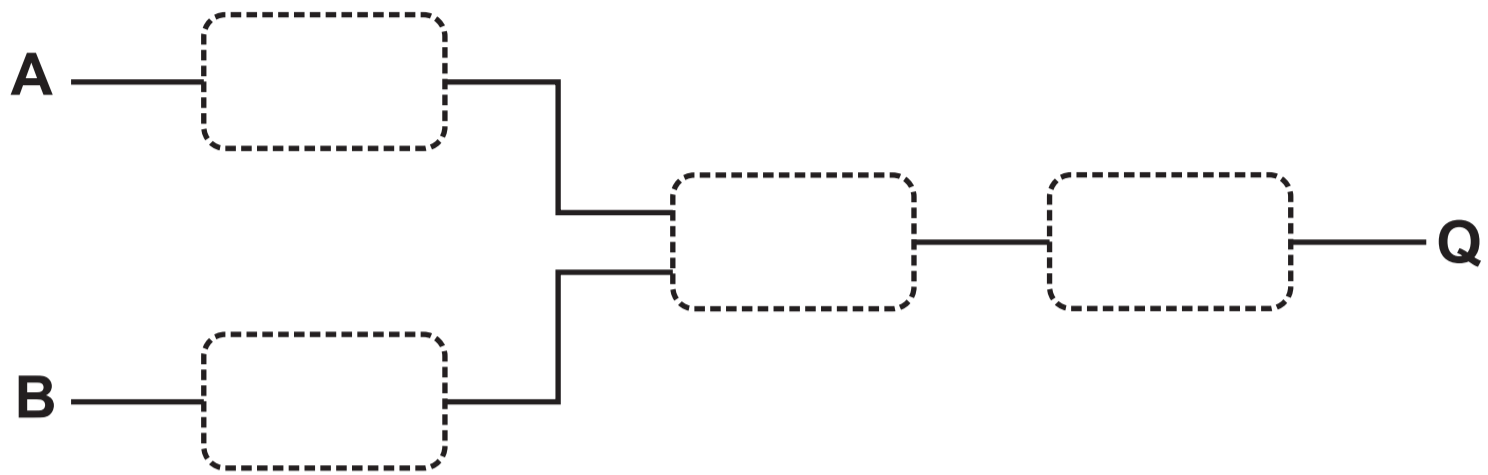
18(e) Use the **E24** resistor series on the **separate insert** to select the preferred value for resistor **R IN OHMS** to ensure that the current flowing through the LED is **NO MORE** than **10 mA**. [1]

\_\_\_\_\_  $\Omega$

**END OF PAPER**

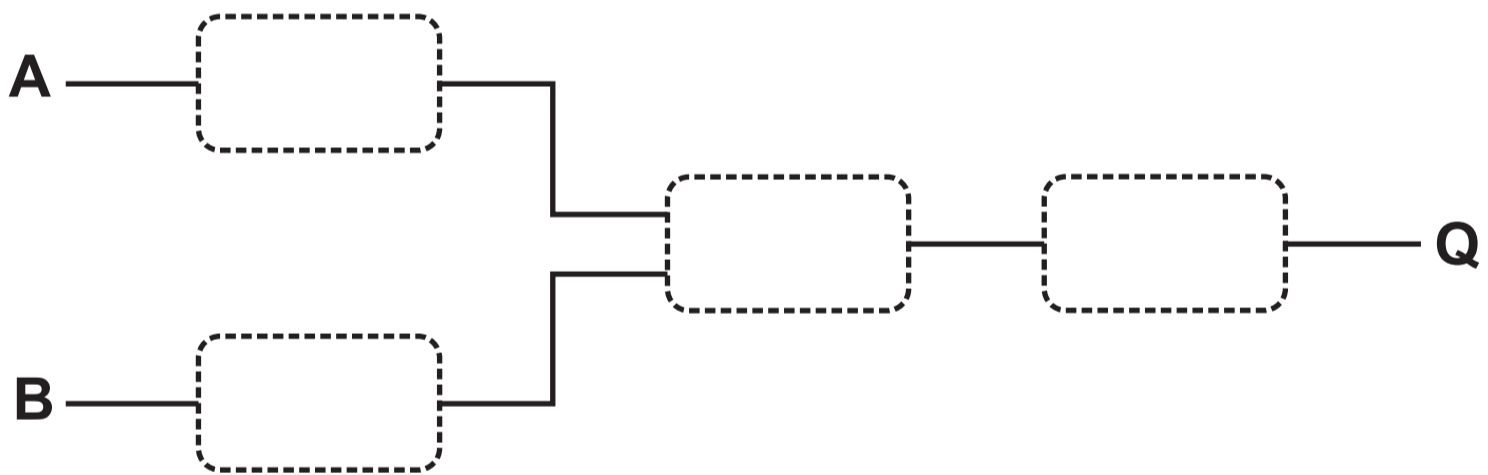
**(a) 2-input OR gate**

**[1]**



**(b) 2-input AND gate**

**[1]**



**(c) 2-input NOR gate**

**[1]**

