Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4161/01

S15-4161-01

ELECTRONICS

UNIT E1: Paper replacement test

A.M. FRIDAY, 12 June 2015

1 hour

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

4161 010001

ADDITIONAL MATERIALS

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

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

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.

INFORMATION SHEET FOR UNIT E1

This information may be of use in answering the questions.

1. Resistor Colour Codes

BLACK	**0**	**GREEN**	**5**
BROWN	**1**	**BLUE**	**6**
RED	**2**	**VIOLET**	**7**
ORANGE	**3**	**GREY**	**8**
YELLOW	**4**	**WHITE**	**9**

The fourth band colour gives the tolerance as follows:

GOLD ± 5%

SILVER ± 10%

2. Preferred Values for Resistors – E24 series

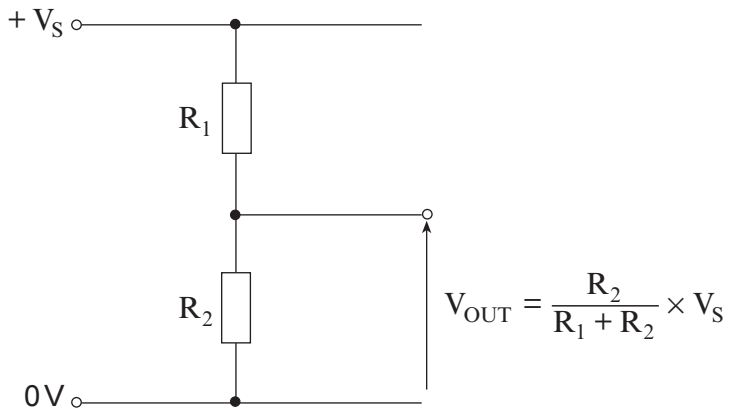
10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82, 91.

3. Resistance = $\frac{\text{voltage}}{\text{current}}$; $R = \frac{V}{I}$.

4. Effective resistance, R, of two resistors R_1 and R_2 in series is given by $R = R_1 + R_2$.

5. Effective resistance, R, of two resistors R_1 and R_2 in parallel is given by $R = \frac{R_1 R_2}{R_1 + R_2}$.

6. Voltage Divider



7. Power = voltage × current; $P = VI = I^2R = \frac{V^2}{R}$.

8. LED The forward voltage drop across a LED is 2 V.

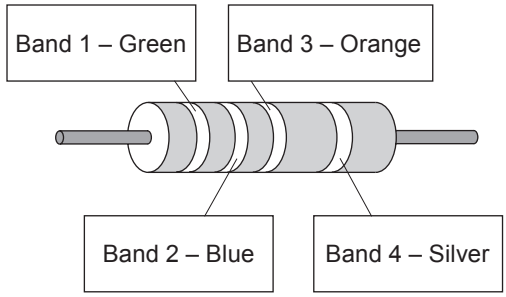
9. NPN Transistors (i) Current gain = $\frac{\text{Collector current}}{\text{Base current}}$; $h_{FE} = \frac{I_C}{I_B}$.

(ii) The forward voltage drop across the base emitter junction is 0.7 V.

Examiner only

Answer **all** *questions.*

1. The diagram shows a resistor.



Write down the value of this resistor in ohms. ..... Ω [3]

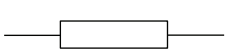
Turn over.

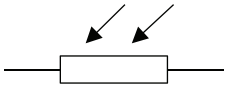
Examiner only

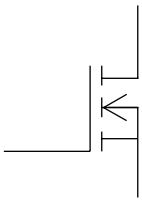
2. *(a)* Here is a list of electronic components.

LDR LED MOSFET Resistor Transistor

Select the correct name for **each** component. [3]

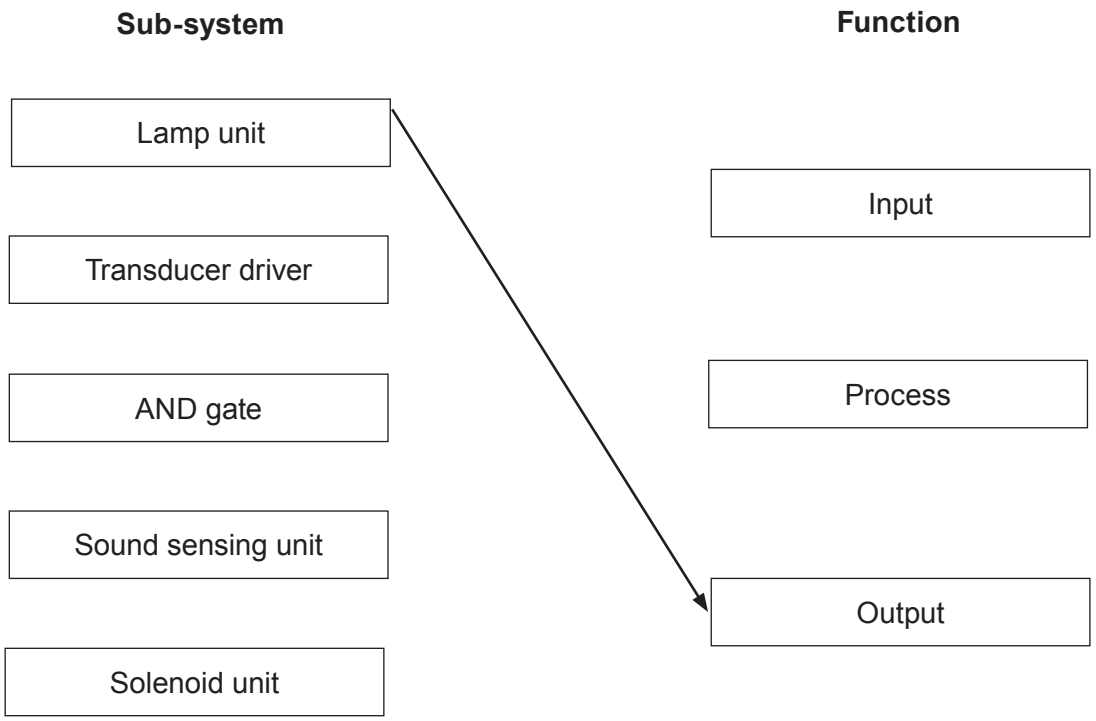






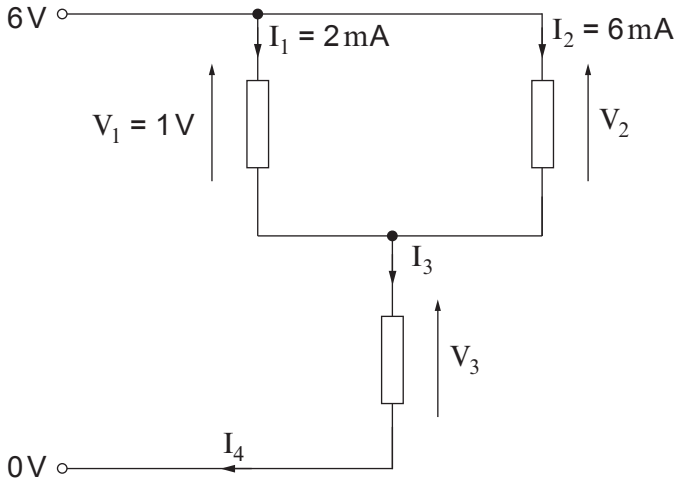
Examiner only

(b) Link each sub-system box on the left to the correct function box on the right. One has been done for you. [4]



Examiner only

3. Study the following circuit.



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

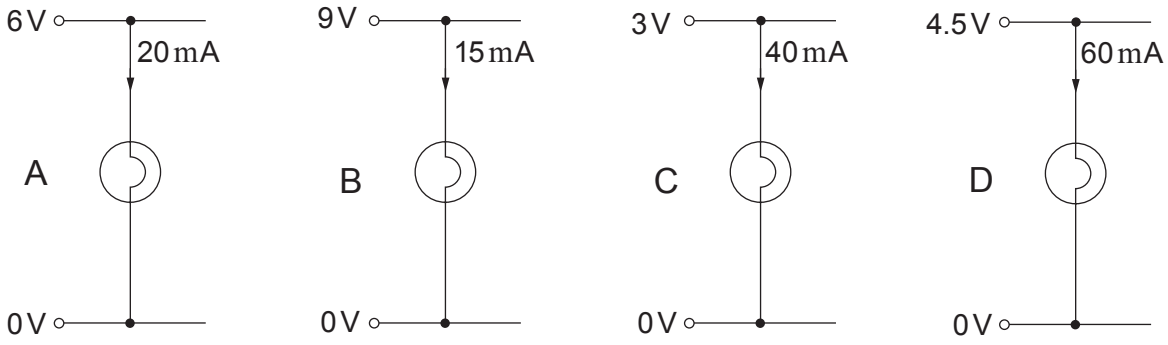
(b) What is the value of I_3? ..... mA

(c) What is the value of V_3? V

(d) What is the value of I_4? ..... mA

Examiner only

4. Here 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 × 40 ☐ P = $\frac{40}{3}$

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

..... mW

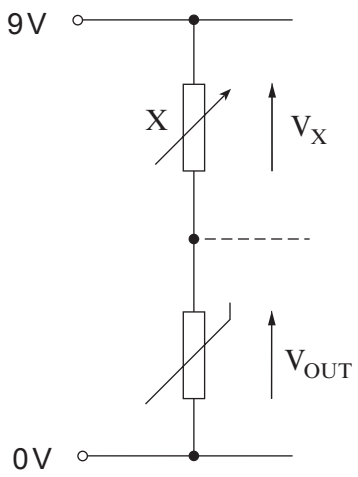
(b) Which **two** lamps use the same power? (Tick (✓) the correct answer.) [1]

☐ A & B ☐ A & C ☐ A & D

☐ B & C ☐ B & D ☐ C & D

Examiner only

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]

0V 1V 2V 3V 4V 5V 6V 7V 8V 9V

(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 0V

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

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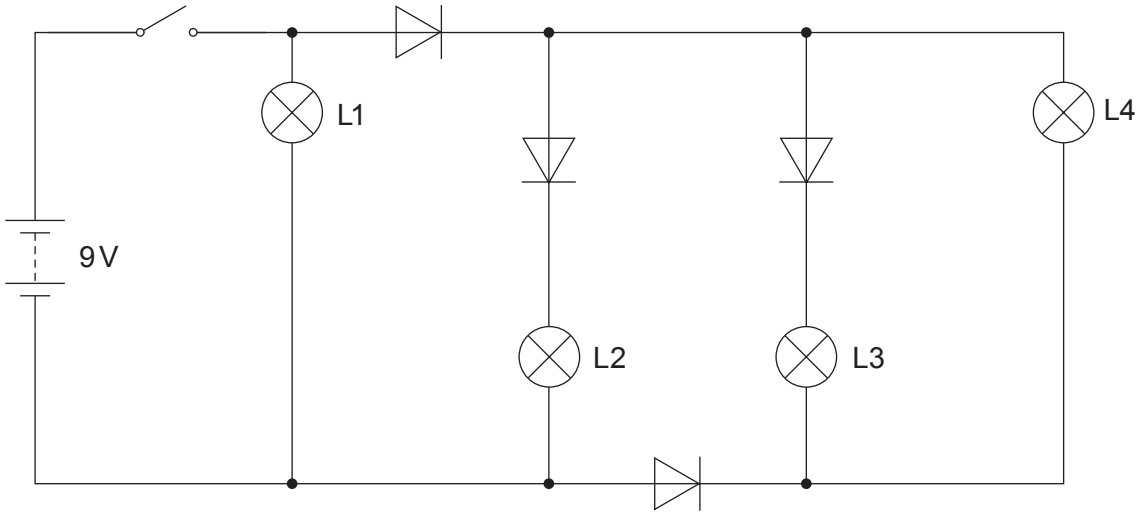
Examiner only

6. The circuit below 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]

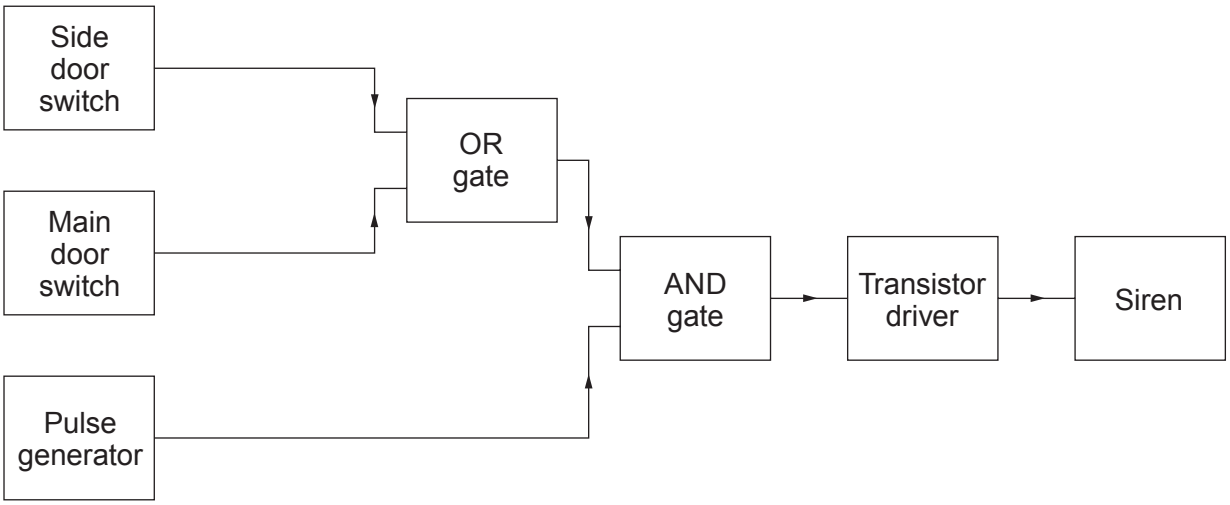
☐	All lamps off	☐	Lamps 1 & 3 on
☐	Lamp 1 on only	☐	Lamps 1, 3 & 4 on
☐	Lamps 1 & 2 on	☐	Lamps 2 & 3 on
☐	Lamps 1, 2 & 3 on	☐	All lamps on

Examiner only

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.

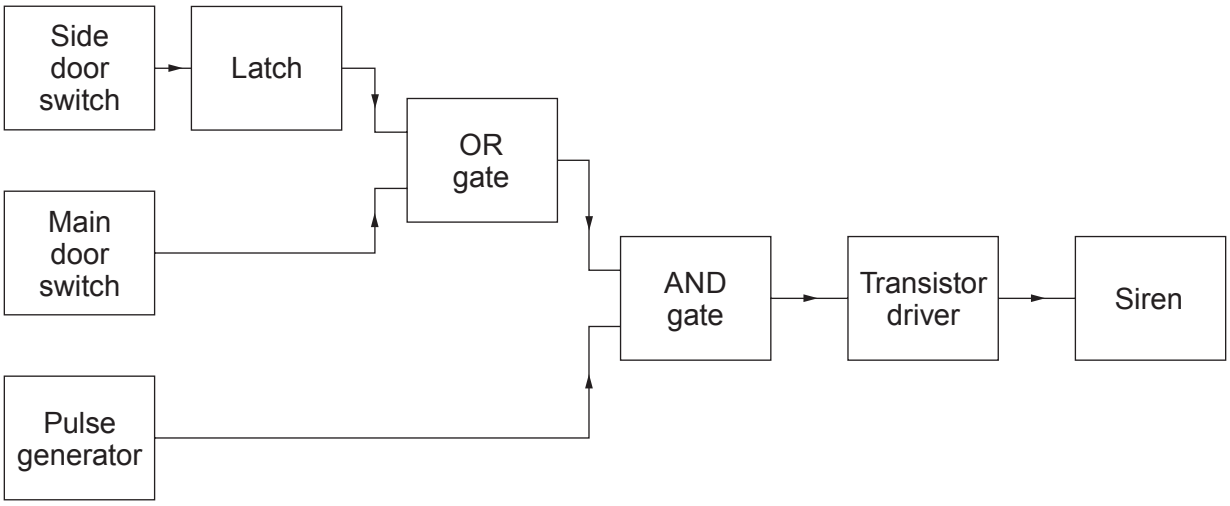
Michael proposes the following design.



When Michael tests the system design as shown above 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.

(a) Describe the effect of the latch on the operation of the following circuit. [1]



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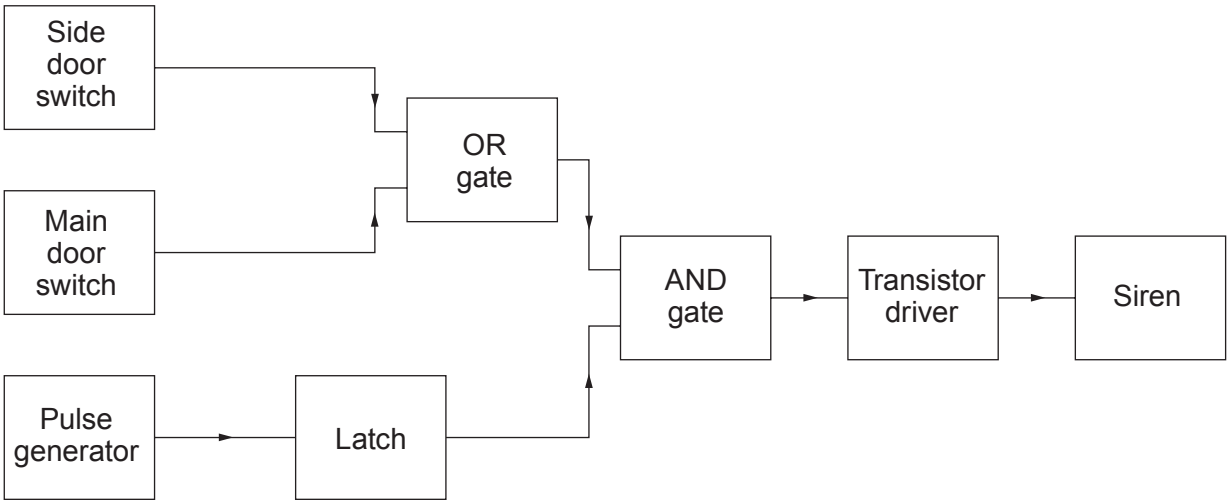
Examiner only

(b) Describe the effect of the latch on the operation of the following circuit. [1]



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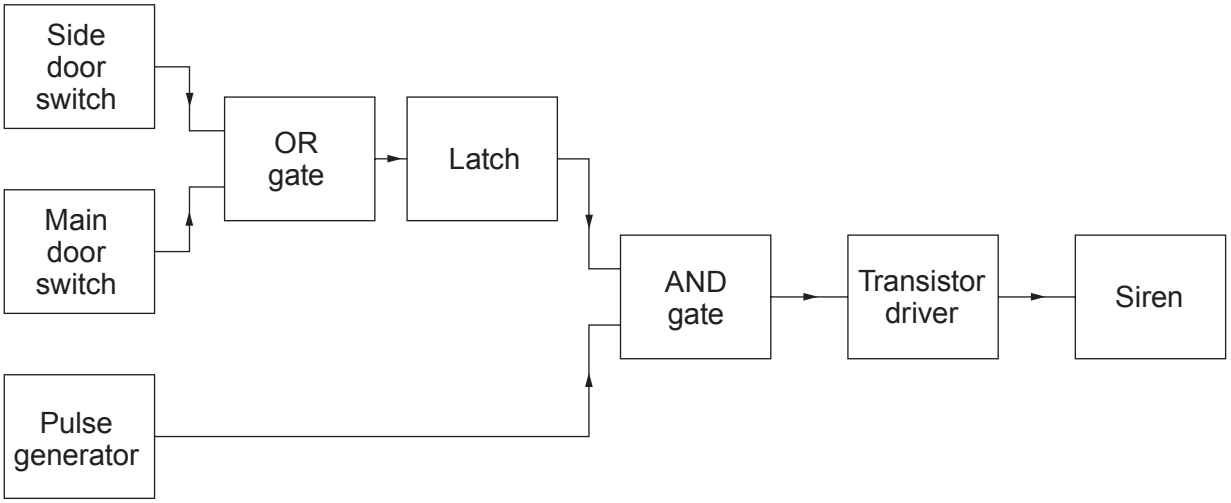
(c) Describe the effect of the latch on the operation of the following circuit. [1]



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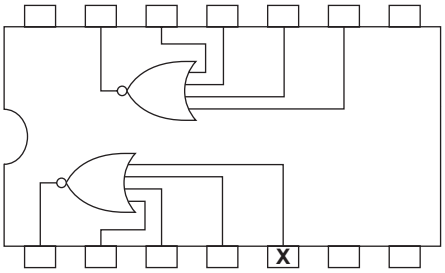
Turn over.

Examiner only

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



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

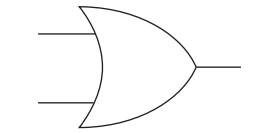
(b) Circle the type of logic gate shown in the IC. [1]

AND gate NAND gate NOR gate NOT gate OR gate

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

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

AND gate NAND gate NOR gate NOT gate OR gate



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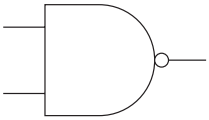

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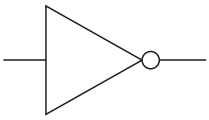

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Examiner only

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

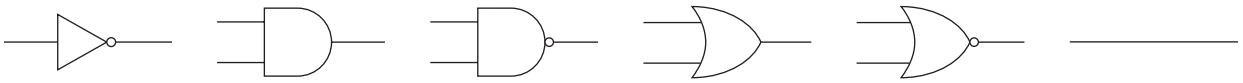
(b) Circle the logic gate that outputs a logic 1 signal **only** when both inputs are at logic 0. [1]

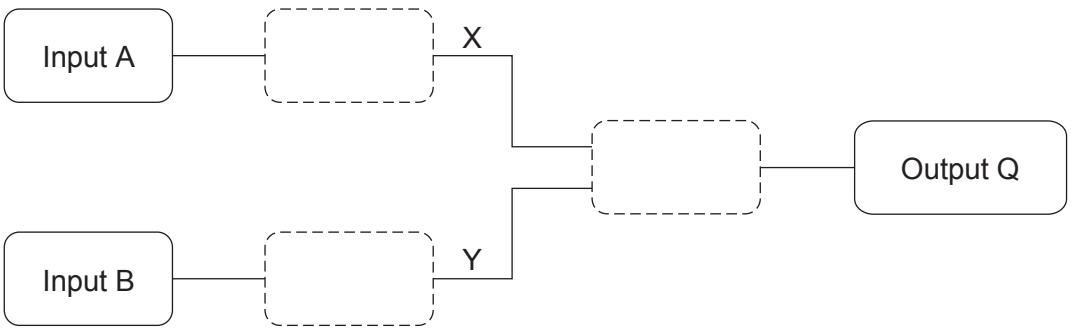
AND gate NAND gate NOR gate NOT gate OR gate

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

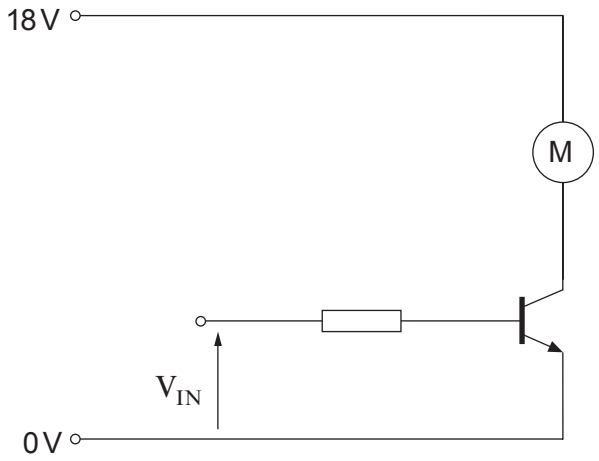
Draw the correct logic gates / connections in the following circuit to produce the truth table given. [3]





Examiner only

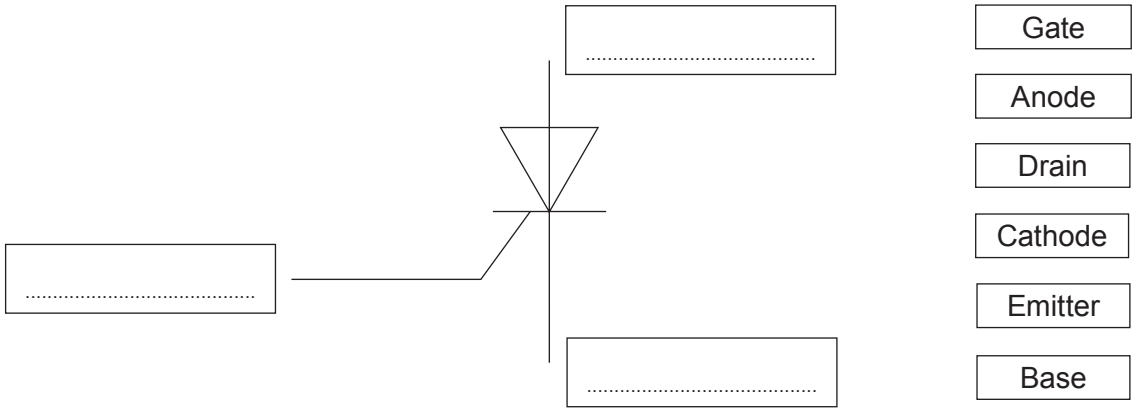
12. The circuit diagram shows part of a system used to switch on a motor.



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.



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

(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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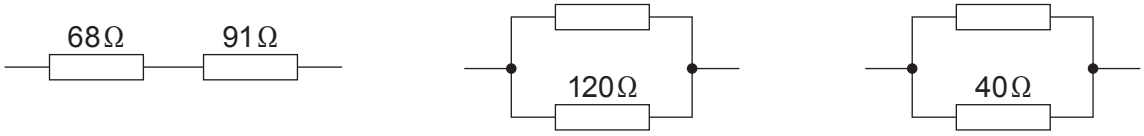
Examiner only

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



Calculate the effective resistance of each combination. [3]

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..... Ω ..... Ω ..... Ω

Examiner only

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) [1]

Inputs		Output
A	**B**	**Q**
0	0	0
0	1	0
1	0	0
1	1	1

☐ **Q = A.B**

☐ **Q = A + $\bar{B}$**

☐ **Q = $\bar{A}$.$\bar{B}$**

☐ **Q = $\overline{A + B}$**

(b) [1]

Inputs		Output
A	**B**	**Q**
0	0	0
0	1	1
1	0	1
1	1	1

☐ **Q = $\bar{A}$.B**

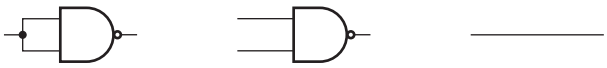
☐ **Q = A + B**

☐ **Q = $\overline{A.B}$**

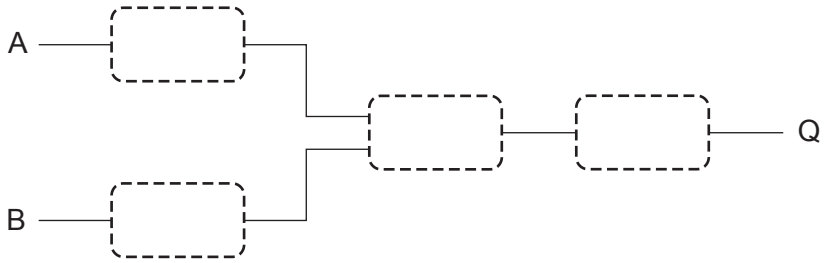
☐ **Q = $\bar{A}$ + $\bar{B}$**

Examiner only

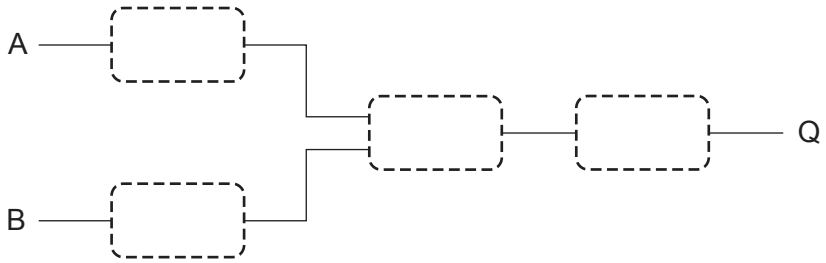
16. Use the symbols below to complete the NAND equivalent circuits for the following logic gates.



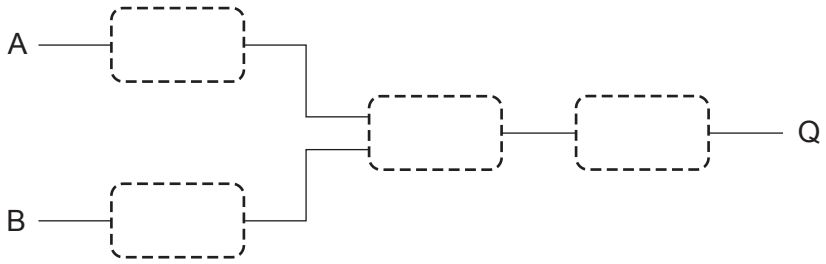
(a) 2-input OR gate [1]



(b) 2-input AND gate [1]



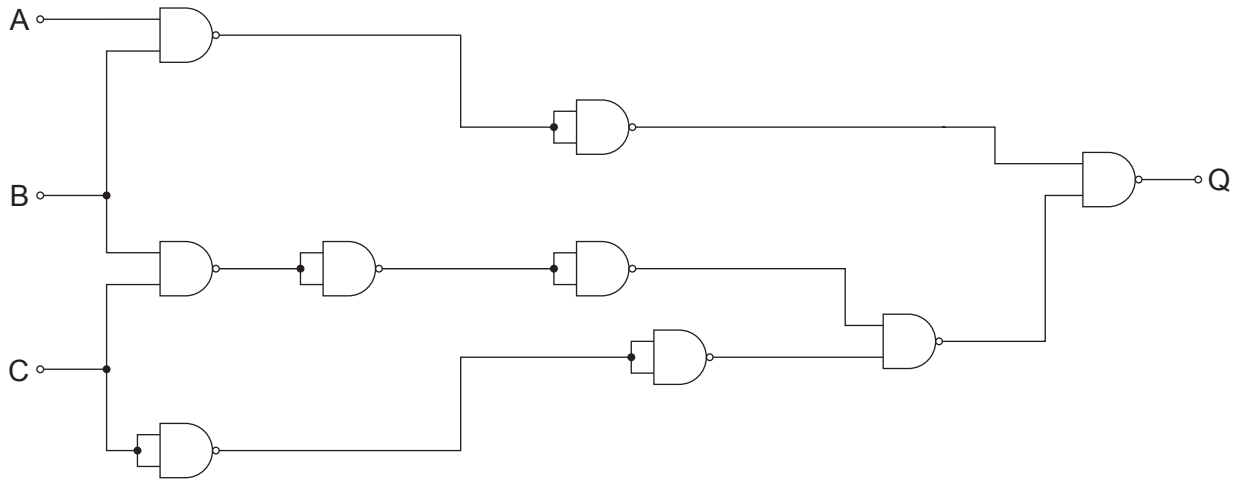
(c) 2-input NOR gate [1]



Turn over.

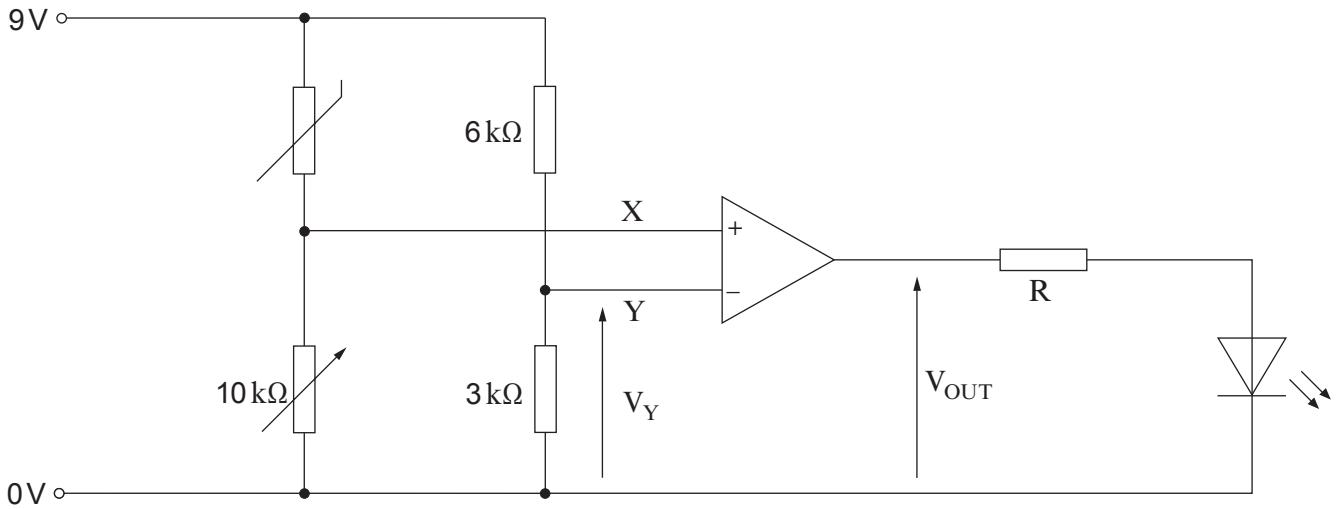
Examiner only

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



Examiner only

18. The following circuit 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]

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

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

(ii) Calculate the voltage V_Y at the inverting input. [1]

V_Y = ... V

(b) At 95 °C, the voltage at 'X' is 3.6 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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(c) What is the purpose of the 10 kΩ variable resistor? [1]

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TURN OVER FOR THE REST OF THE QUESTION.

Examiner only

(d) The comparator output is 9 V, and the LED has a forward voltage drop of 2 V when a current of 10 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. ..... kΩ

(e) Use the E24 resistor series on the information sheet on page 2 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]

..... Ω

END OF PAPER