0 1 . 1 Complete the truth table for the AND logic gate.

[1 mark]

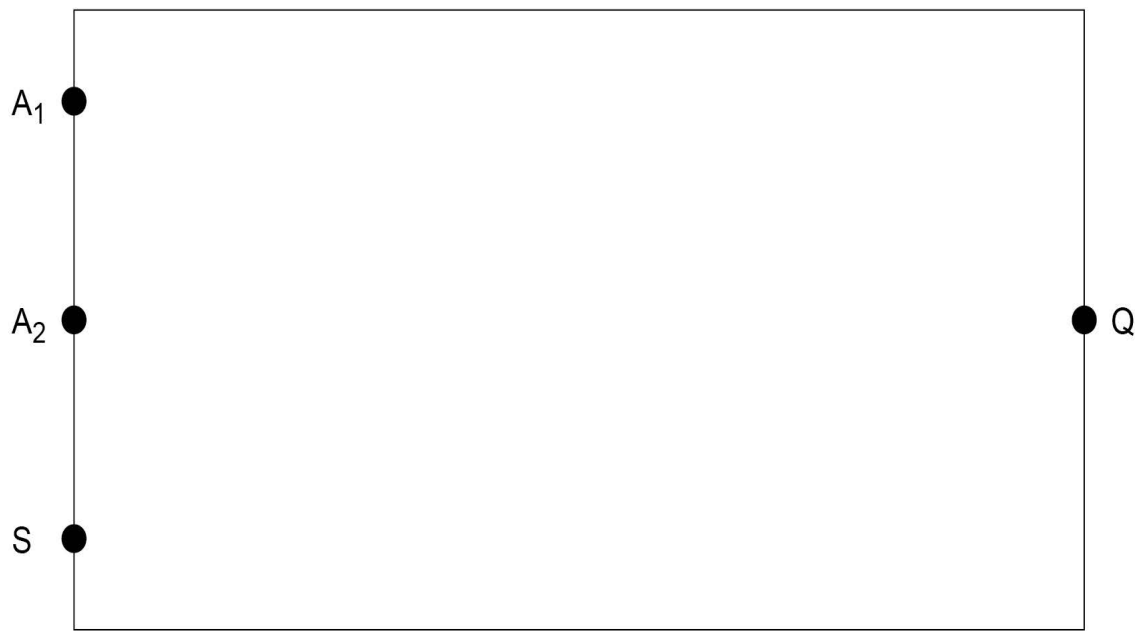
A	B	A AND B
0	0	
0	1	
1	0	
1	1	

0 1 . 2 A logic circuit is being developed for an audio advert in a shop that plays automatically if a customer is detected nearby.

- The system has two sensors, A_1 and A_2, that detect if a customer is near. The audio plays if either of these sensors is activated.
- The system should only play if another audio system, S, is not playing.
- The output from the circuit, for whether the advert should play or not, is Q.

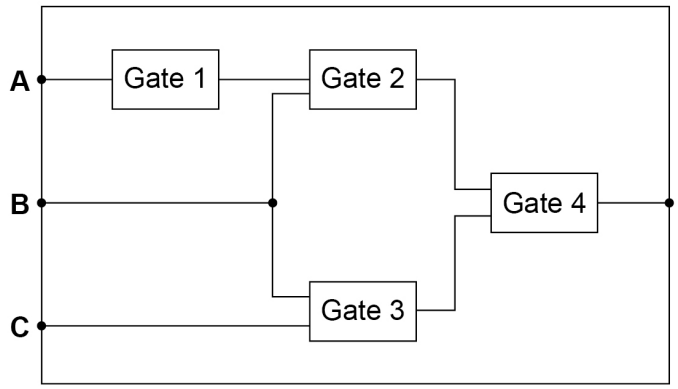
Complete the logic circuit for this system.

[3 marks]



0 2 The expression `(B AND (NOT A)) OR (B AND C)` can be represented by the logic circuit shown in **Figure 5**. In the circuit the logic gates are marked with labels instead of their proper symbols.

Figure 5



0 2 . 1 State the name of the logic gate used at Gate 1 in **Figure 5**.

[1 mark]

0 2 . 2 State the name of the logic gate used at Gate 2 in **Figure 5**.

[1 mark]

0 2 . 3 Draw the logic circuit symbol in the space below for the logic gate used at Gate 3 in **Figure 5**.

[1 mark]

0 2 . 4 Draw the logic circuit symbol in the space below for the logic gate used at Gate 4 in **Figure 5**.

[1 mark]

0 2 . 5 Complete the truth table for the Boolean expression:

(X AND Y) OR (NOT X)

[3 marks]

X	Y	X AND Y	NOT X	(X AND Y) OR (NOT X)
0	0			
0	1			
1	0			
1	1			

0 2 . 6 A truth table for the complex Boolean expression:

(A1 AND (NOT A2) AND A3) OR (A1 AND A2 AND A3)

is shown in **Figure 6**.

Figure 6

A1	A2	A3	OUTPUT
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1

Shade **one** lozenge which shows a simpler expression which is the equivalent of the original, more complex, expression.

[1 mark]

A NOT A1 ⬭

B A2 OR A3 ⬭

C A1 AND (NOT A2) ⬭

D A1 AND A3 ⬭

0 3 . 1 State the name of the logic gate represented by the following truth table.

[1 mark]

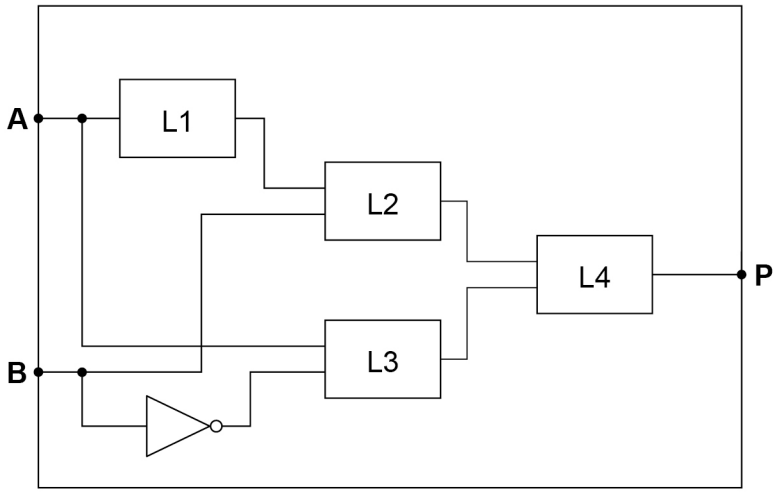
Input A	Input B	Output
0	0	0
0	1	0
1	0	0
1	1	1

Logic gate _____

A partially complete logic circuit is shown in **Figure 2** that detects if a computer system has been set up correctly. There are two keyboard input devices, keyboard **A** and keyboard **B**, and either one can be connected to the computer system. However, if they are both connected then the computer system will not work.

Output **P** has the value 1 if either keyboard **A** or keyboard **B**, but not both, is connected to the computer system and 0 otherwise.

Figure 2



0 3 . 2 State the name of the logic gates that should be placed in the positions indicated by the labels **L1**, **L2**, **L3** and **L4** in **Figure 2**.

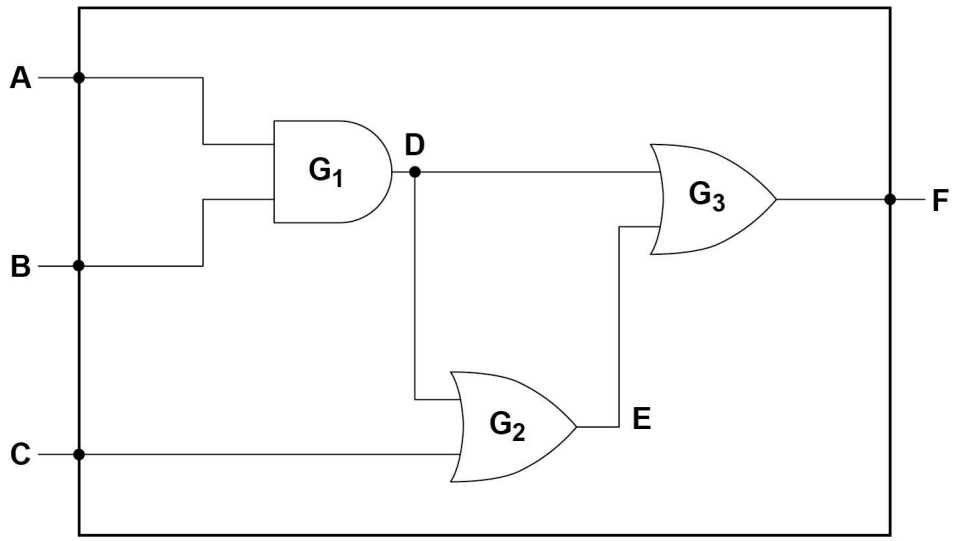
[3 marks]

Label	Logic gate
L1	
L2	
L3	
L4	

Turn over for the next question

0 4 **Figure 3** shows a logic circuit.

Figure 3



0 4 . 1 State the type of logic gate labelled G_1 in **Figure 3**.

[1 mark]

G_1: _____

0 4 . 2 State the type of logic gate labelled G_2 in **Figure 3**.

[1 mark]

G_2: _____

0 4 . 3 State what a NOT gate does.

[1 mark]

_____

_____

0 4 . 4 Complete the following truth table for the logic circuit shown in **Figure 3** by filling in the grey shaded cells.

[3 marks]

A	B	C	D	E	F
0	0	0	0	0	0
0	0	1	0	1	1
0	1	0	0	0	0
0	1	1	0	1	1
1	0	0			
1	0	1	0	1	1
1	1	0	1		
1	1	1			

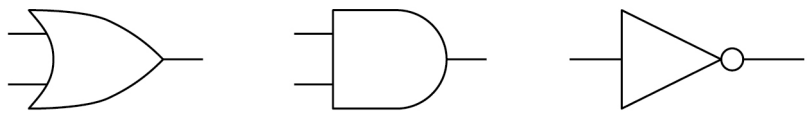
Turn over for the next question

0 5 A burglar alarm sounds an alarm when it is armed (turned on) and the window or door is opened.

The truth table for this basic system is shown in **Figure 4**.

Figure 4

Armed (A) 0 = Off 1= On	Door (B) 0 = Closed 1 = Open	Window (C) 0 = Closed 1 = Open	Alarm (Q) 0 = Off 1 = On
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1



OR AND NOT

Draw the logic circuit that represents the truth table in **Figure 4**. You **must** use the correct symbols for logic gates. You may not need to use all the gates shown.

[3 marks]

0 6 . 1 Complete the truth table for the XOR logic gate.

[1 mark]

A	B	A XOR B
0	0	
0	1	
1	0	
1	1	

0 6 . 2 A game uses three sensors.

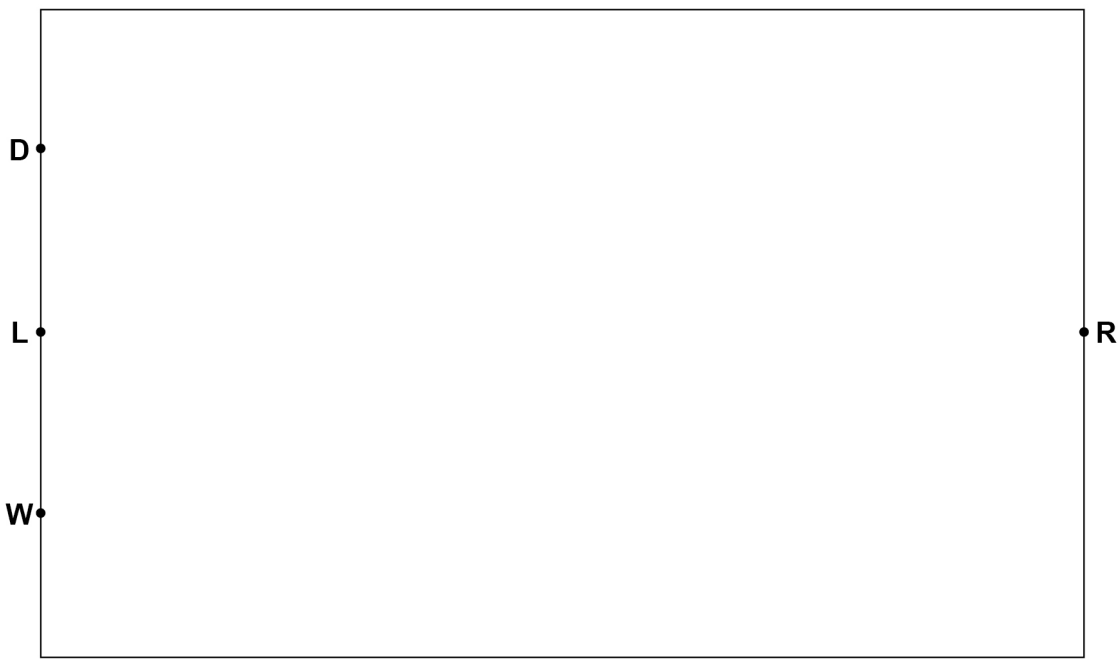
A red light (**R**) in the game switches on if **all** of the following conditions are true:

- sensor **D** is off
- sensor **L** is on
- sensor **W** is on.

Complete the logic circuit for this game.

You **must** use the correct symbols for the logic gates.

[3 marks]



0 6 . 3 Another circuit in the game will output True if any two sensors are activated or if all three sensors are activated. This has been represented as the Boolean expression:

$$(W \,.\, D) + (D \,.\, L) \,.\, (W \,.\, L)$$

The expression contains an error.

Shade **one** lozenge that shows the expression with the error corrected.

[1 mark]

A $(W \,.\, D) \,.\, (D \,.\, L) \,.\, (W \,.\, L)$ ⬭

B $\left(\overline{W} \,.\, D\right) \,.\, (D \,.\, L) + (W \,.\, L)$ ⬭

C $(W \,.\, D) + (D \,.\, L) + (W \,.\, L)$ ⬭

D $\left(\overline{W} \,.\, D\right) + (D + L) \,.\, (W \,.\, L)$ ⬭

0 6 . 4 A green light (**G**) in the game switches on if **all** of the following conditions are true:

- sensor **D** is off
- sensor **L** is off
- sensor **W** is on.

Write a Boolean expression for this logic circuit.

You **must** use Boolean expression operators in your answer.

[3 marks]

G = _____

_____

Turn over for the next question

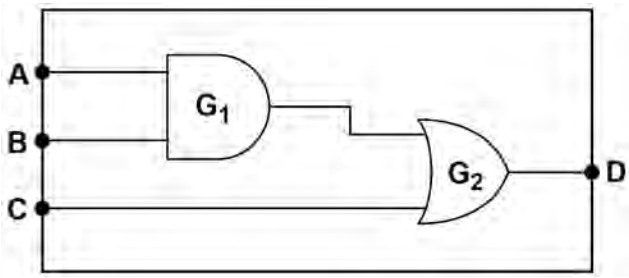
0 7 . 1 Complete the truth table for the **XOR** logic gate.

[1 mark]

A	B	A XOR B
0	0	
0	1	
1	0	
1	1	

Figure 3 shows a logic circuit.

Figure 3



0 7 . 2 State the type of logic gate labelled G_1 in **Figure 3**.

[1 mark]

_____

0 7 . 3 Write a Boolean expression to show how the output **D** is calculated from the inputs **A**, **B** and **C** in **Figure 3**.

You **must** use the correct symbols for the Boolean operators in your expression.

[2 marks]

D = _____

0 8 . 1 Complete the truth table for the AND logic gate.

[1 mark]

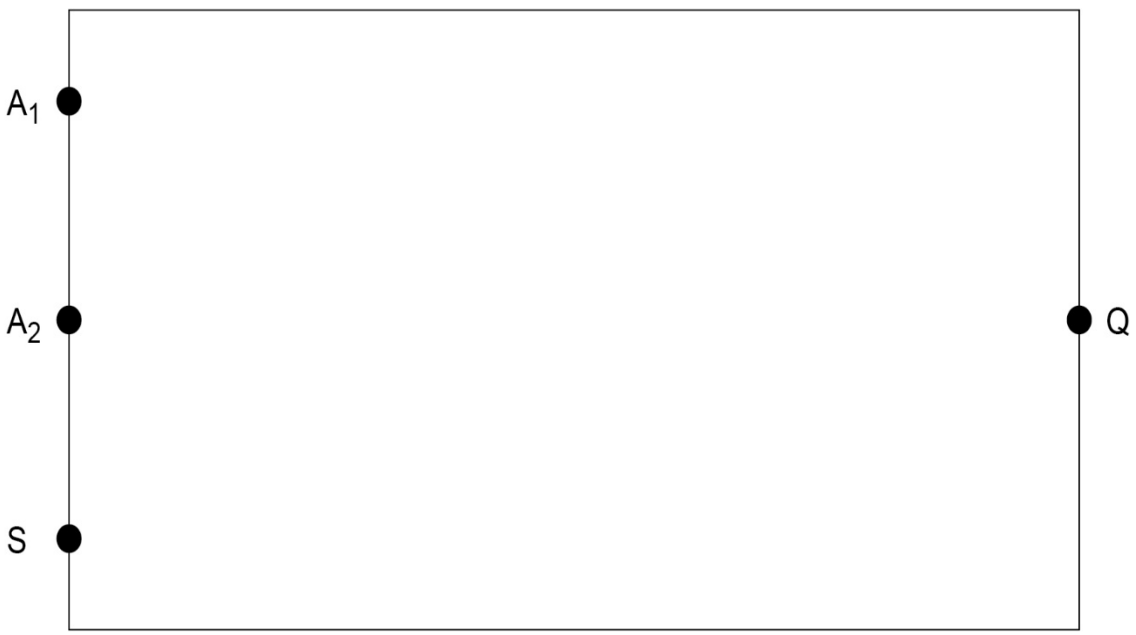
A	B	A AND B
0	0	
0	1	
1	0	
1	1	

0 8 . 2 A logic circuit is being developed for an audio advert in a shop that plays automatically if a customer is detected nearby.

- The system has two sensors, A_1 and A_2, that detect if a customer is near. The audio plays if either of these sensors is activated.
- The system should only play if another audio system, S, is not playing.
- The output from the circuit, for whether the advert should play or not, is Q.

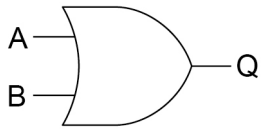
Complete the logic circuit for this system.

[3 marks]



0 9 **Figure 4** shows a logic gate.

Figure 4



0 9 . 1 Which truth table matches the logic gate in **Figure 4**?

Shade **one** lozenge.

[1 mark]

A

A	B
0	1
1	0

B

A	B	Q
0	0	0
0	1	0
1	0	0
1	1	1

C

A	B	Q
0	0	0
0	1	1
1	0	1
1	1	1

D

A	B	Q
0	0	0
0	1	1
1	0	1
1	1	0

0 9 . 2 **Figure 5** shows a truth table.

Figure 5

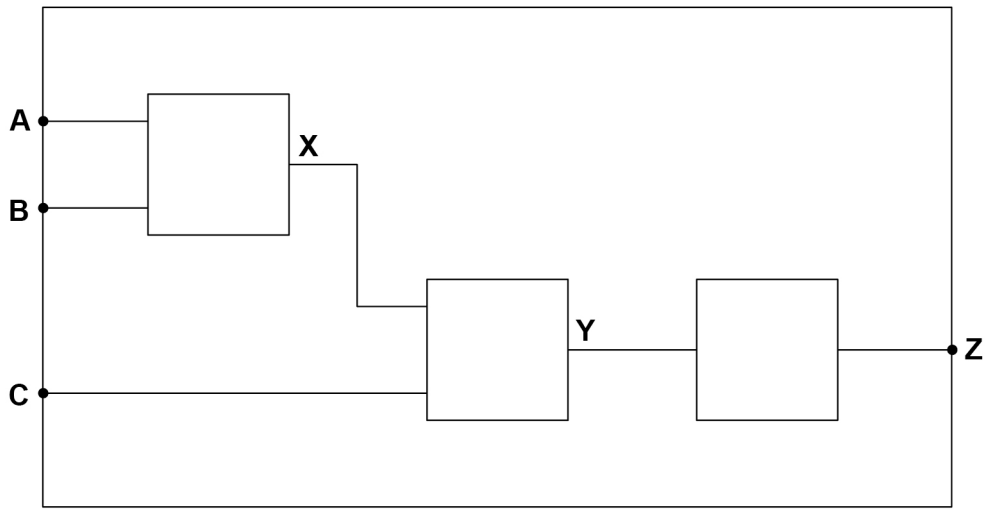
A	B	C	X	Y	Z
0	0	0	0	0	1
0	0	1	0	1	0
0	1	0	0	0	1
0	1	1	0	1	0
1	0	0	0	0	1
1	0	1	0	1	0
1	1	0	1	1	0
1	1	1	1	0	1

Complete the logic circuit by writing the **name** of a logic gate in each empty box.

The completed logic circuit should have the same functionality as the circuit represented by the truth table in **Figure 5**.

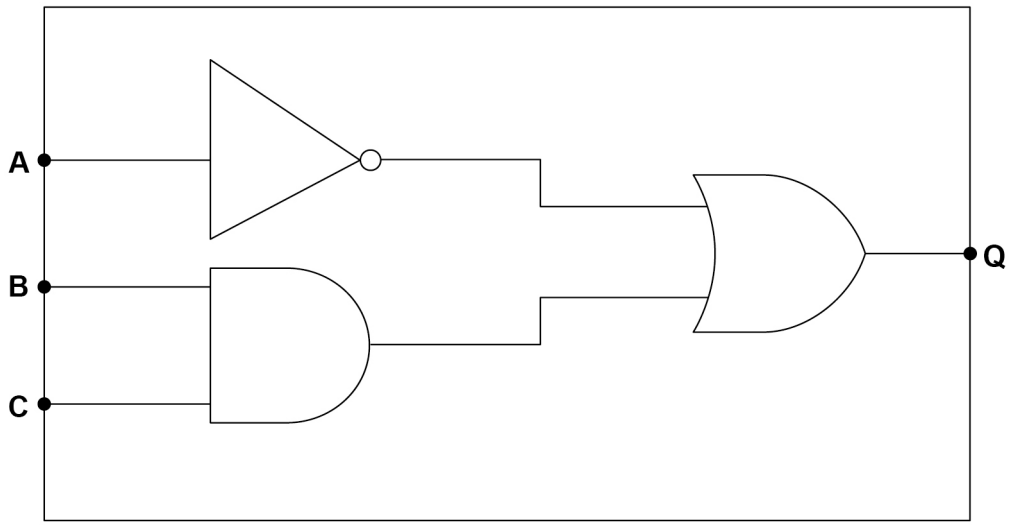
You should write the **name** of **one** logic gate only in each box.

[3 marks]



0 9 . 3 **Figure 6** shows a different logic circuit.

Figure 6



Write a Boolean expression that represents the logic circuit shown in **Figure 6**.

You **must** use the correct symbols for the Boolean operators in your expression.

[3 marks]

Q = _____

_____