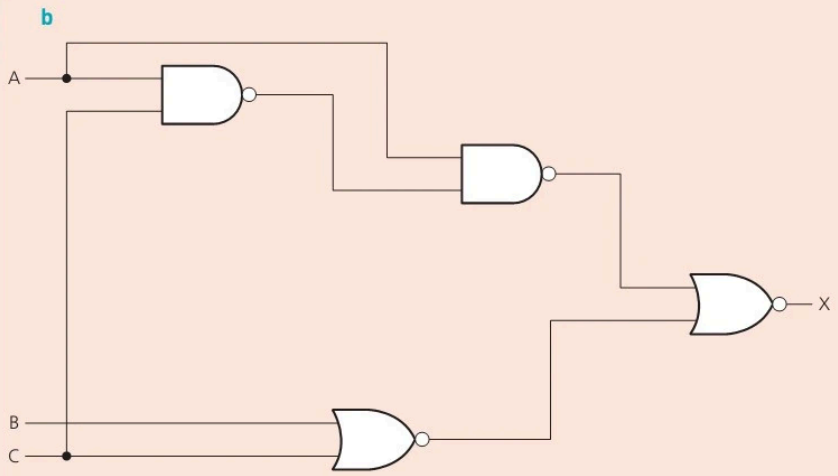


▲ **Figure 10.20**

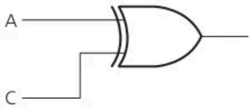
Example 3

A logic circuit can be represented by the following logic expression: (A XOR C) OR (NOT C NAND B)

Produce a logic circuit and a truth table from the above statement.

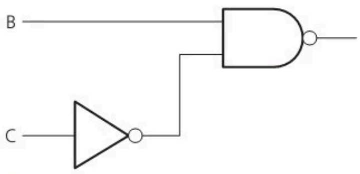
In this example we have a connecting logic gate which is OR.

So, if we produce one half of the circuit from (A XOR C) we get:



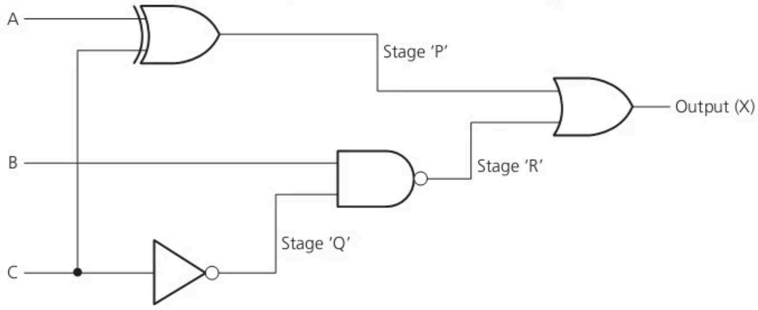
▲ **Figure 10.21**

The other half of the circuit is found from (NOT C NAND B):



▲ **Figure 10.22**

If we now combine these together to form the final logic circuit:



▲ **Figure 10.23**

The truth table is shown:

▼ **Table 10.13**

Input values			Values at stages:			Output
A	**B**	**C**	**'P'**	**'Q'**	**'R'**	**X**
0	0	0	0	1	1	1
0	0	1	1	0	1	1
0	1	0	0	1	0	0
0	1	1	1	0	1	1
1	0	0	1	1	1	1
1	0	1	0	0	1	1
1	1	0	1	1	0	1
1	1	1	0	0	1	1

? Example 4

Look at the two truth tables below; in each case produce a logic expression and the corresponding logic circuit:

a

▼ **Table 10.14**

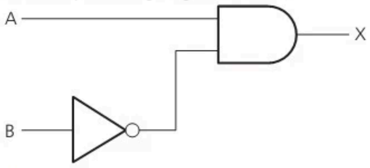
Inputs		Output
A	**B**	**X**
0	0	0
0	1	0
1	0	1
1	1	0

To produce the logic statement, we only concern ourselves with the truth table row where the output value is 1. In this case, A = 1 and B = 0 which gives the logical expression:

A AND NOT B

So we have the logic expression: A AND NOT B

(Note that this could be written as $A \cdot \overline{B}$ in Boolean.) It is now possible to draw the corresponding logic circuit:



▲ **Figure 10.24**

b

▼ Table 10.15

Inputs		Output
A	B	X
0	0	0
0	1	1
1	0	0
1	1	1

This time we have **two** rows where the output is 1; this gives the following logical expressions:

(NOT A AND B)

(A AND B)

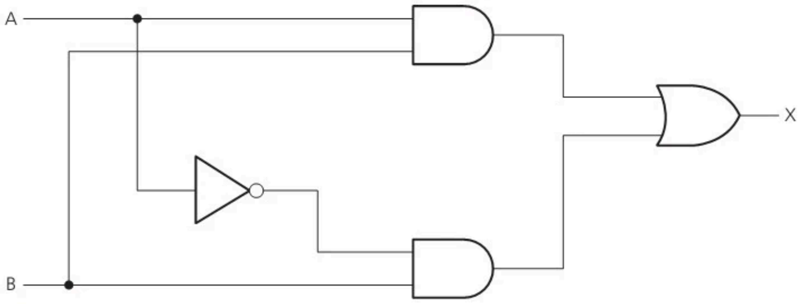
We now join these together using an OR gate to give:

(NOT A AND B) OR (A AND B)

So we have the logic expression: (NOT A AND B) OR (A AND B)

(This could be written as: $\overline{A} . B + A . B$)

It is now possible to draw the corresponding logic circuit:



▲ **Figure 10.25**

Example 5

a Which Boolean expression is represented by the following truth table?

▼ Table 10.16

Input values			Output
A	B	C	X
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

We only need to consider those rows where the output is a 1. This gives us the following three logic expressions:

(NOT A AND NOT B AND NOT C)
(A AND NOT B AND NOT C)
(A AND B AND NOT C)

If we now join the three expressions with an OR gate, we end up with the final logic expression:

(NOT A AND NOT B AND NOT C) OR (A AND NOT B AND NOT C) OR (A AND B AND NOT C)

b i Which logic expression is represented by the following truth table?
ii Show that your logic expression in part i is the same as: (B AND C) OR (A AND C) OR (A AND B)

Table 10.17

A	B	C	X
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

i We only need to consider those rows where the output is a 1. This gives us the following four Boolean expressions:

(NOT A AND B AND C)
(A AND NOT B AND C)
(A AND B AND NOT C)
(A AND B AND C)

If we now join the four expressions with an OR gate we end up with the following logic expression:

(NOT A AND B AND C) OR (A AND NOT B AND C) OR (A AND B AND NOT C) OR (A AND B AND C)

ii To show that **(B AND C) OR (A AND C) OR (A AND B)** produces the same output as that shown in part i we need to produce a new truth table and show that the output is the same as the one in the given truth table:

Table 10.18

A	B	C	B AND C	A AND C	A AND B	(B AND C) OR (A AND C) OR (A AND B)	X
0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0
0	1	0	0	0	0	0	0
0	1	1	1	0	0	1	1
1	0	0	0	0	0	0	0
1	0	1	0	1	0	1	1
1	1	0	0	0	1	1	1
1	1	1	1	1	1	1	1

As the second truth table shows, the outputs from logic expressions are both the same; thus the logic expression **(B AND C) OR (A AND C) OR (A AND B)** gives the same output as the logic expression in part i.