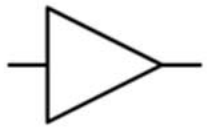
Chapter 10

BOOLEAN LOGIC

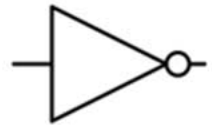
Content overview *Candidates study the following topics:*	In this chapter you will learn about:
Computer systems 1. Data representation 2. Data transmission 3. Hardware 4. Software 5. The internet and its uses 6. Automated and emerging technologies **Algorithms, programming and logic** 7. Algorithm design and problem-solving 8. Programming 9. Databases 10. Boolean logic	**1. the identification, definition, symbols and functions of the standard logic gates:** **NOT, AND, OR, NAND, NOR and XOR** **2. how to use logic gates to create logic circuits from:** ○ a given problem ○ a logic expression ○ a truth table **3. how to complete truth tables from:** ○ a given problem ○ a logic expression ○ a logic circuit **4. how to write a logic expression from:** ○ a given problem ○ a logic circuit ○ a truth table.

Buffer



Input	Output
0	0
1	1

Inverter



Input	Output
0	1
1	0

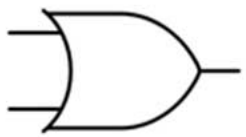
AND

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

NAND

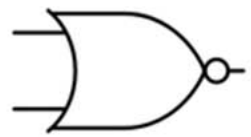
A	B	Output
0	0	1
1	0	1
0	1	1
1	1	0

OR



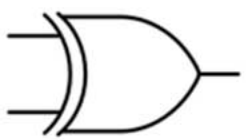
A	B	Output
0	0	0
1	0	1
0	1	1
1	1	1

NOR



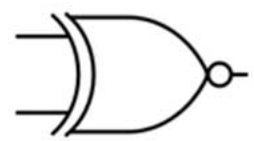
A	B	Output
0	0	1
1	0	0
0	1	0
1	1	0

XOR



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

XNOR



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

Consider this logic expression.

X = (**A** AND **B**) OR (**B** AND NOT **C**)

Draw a logic circuit for this logic expression.

Each logic gate must have a maximum of **two** inputs.

Do **not** simplify this logic expression.

Consider this logic expression.

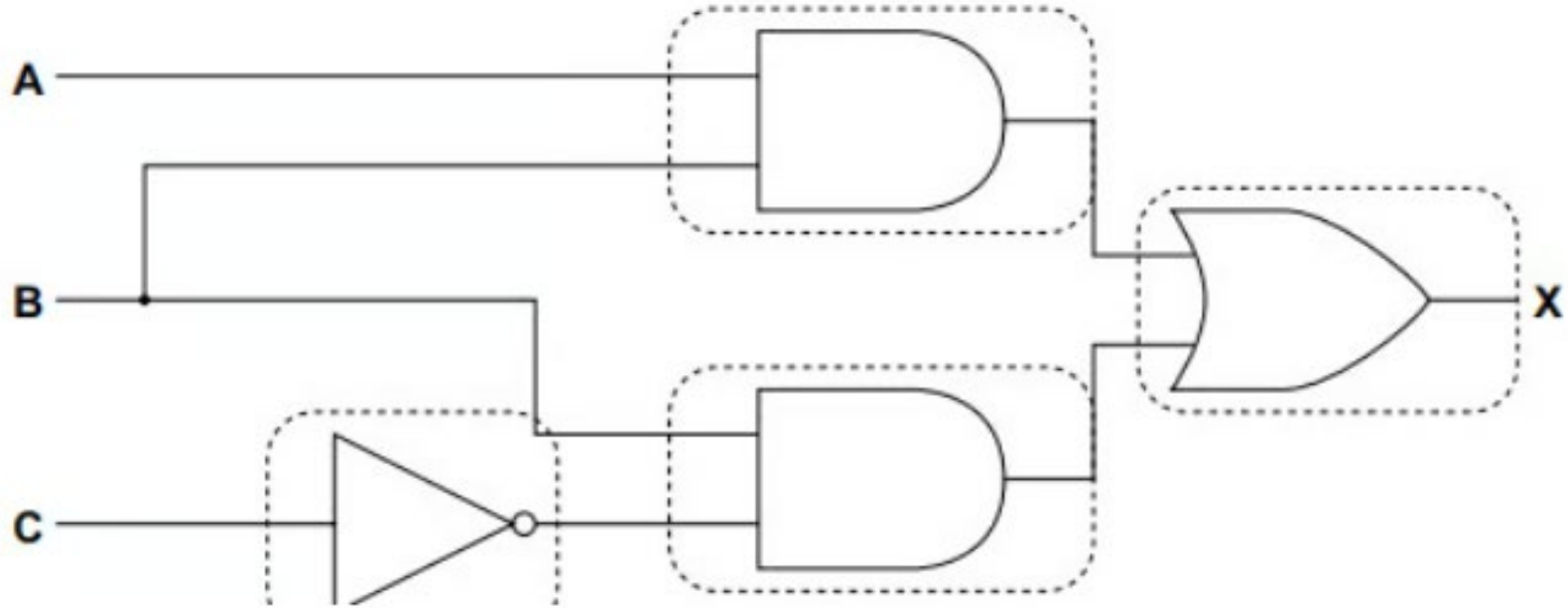
X = (**A** AND **B**) OR (**B** AND NOT **C**)

Draw a logic circuit for this logic expression.

Each logic gate must have a maximum of **two** inputs.

Do **not** simplify this logic expression.

The completed logic circuit would be:



Consider this logic expression.

X = (**A** AND **B**) OR (**B** AND NOT **C**)

Complete the truth table from the given logic expression.

A	B	C	Working space	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

Consider this logic expression.

X = (**A** AND **B**) OR (**B** AND NOT **C**)

Complete the truth table from the given logic expression.

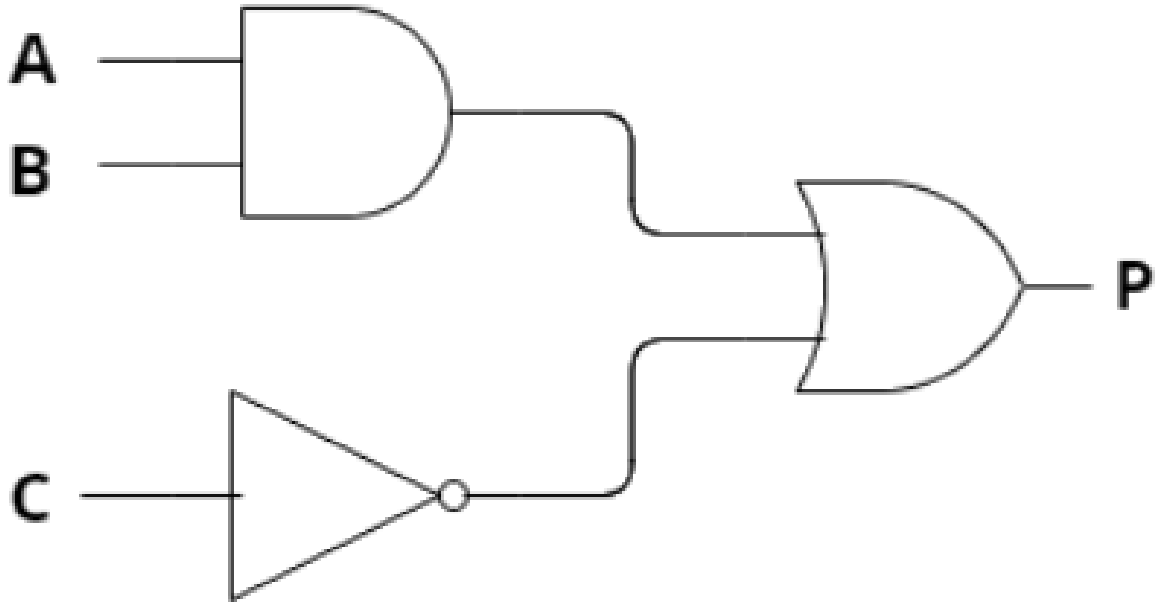
A	B	C	Working space	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

Consider this logic expression.

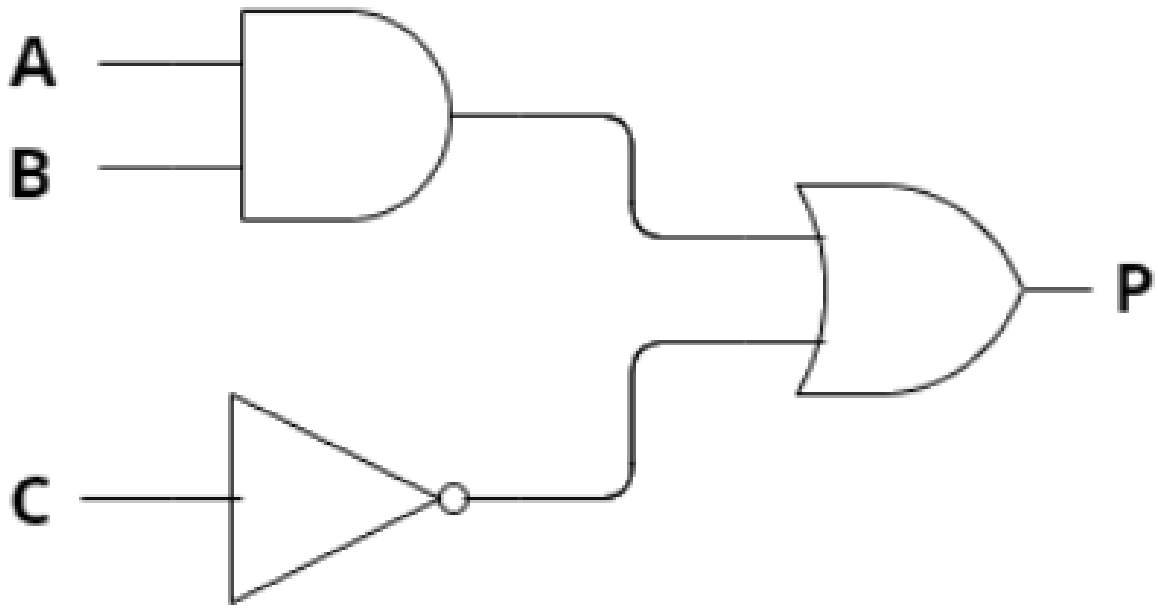
X = (**A** AND **B**) OR (**B** AND NOT **C**)

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

Write the **Boolean expression** represented by the logic diagram below:



Write the **Boolean expression** represented by the logic diagram below:



The Boolean expression for the logic diagram can be expressed as:

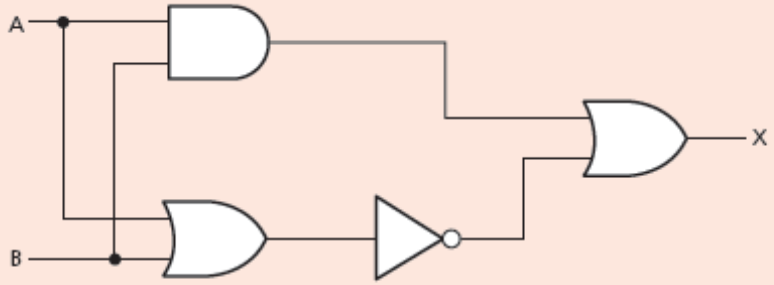
- `P = (A AND B) OR (NOT C)` **OR** `P = (A ^ B) V (¬C)`
- `(A AND B)` **[1 mark]**
- `(NOT C)` **[1 mark]**
- `(A AND B) OR (NOT C)` **[1 mark]**

Activity p.364

Activity 10.2

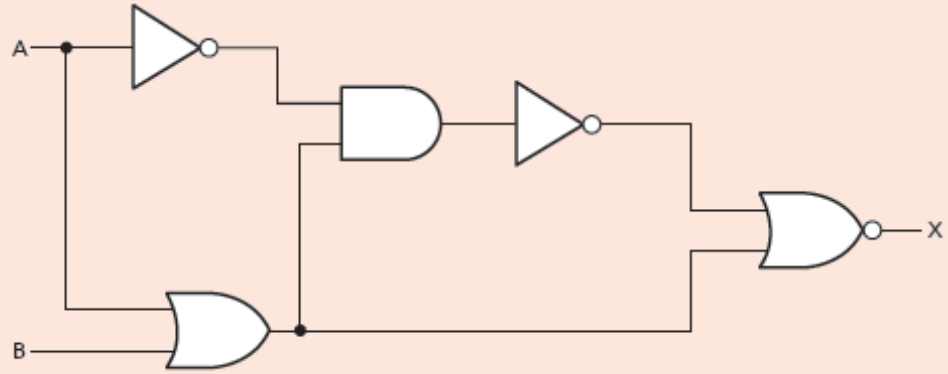
1 Produce truth tables from the following logic circuits:

a



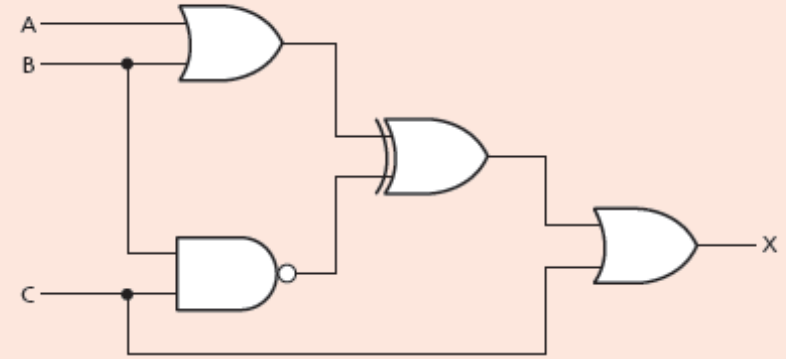
▲ Figure 10.14

b



▲ Figure 10.15

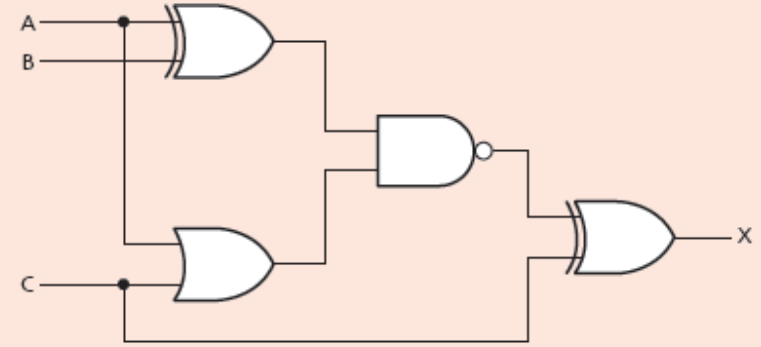
c



▲ Figure 10.16

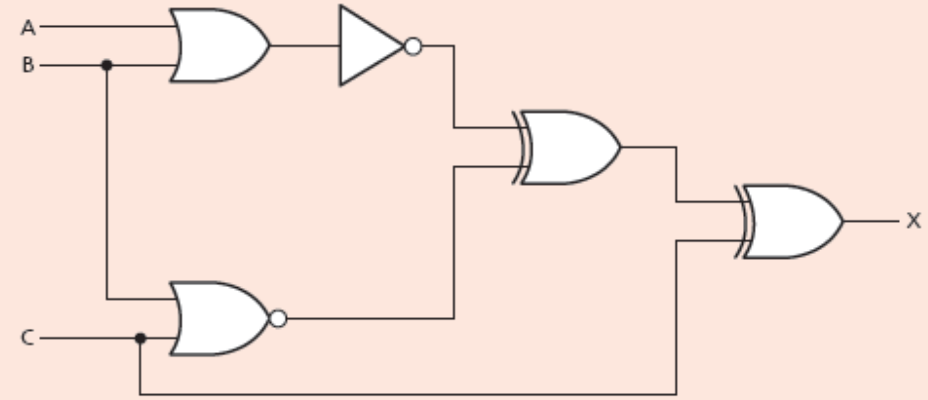
Activity p.365

d



▲ Figure 10.17

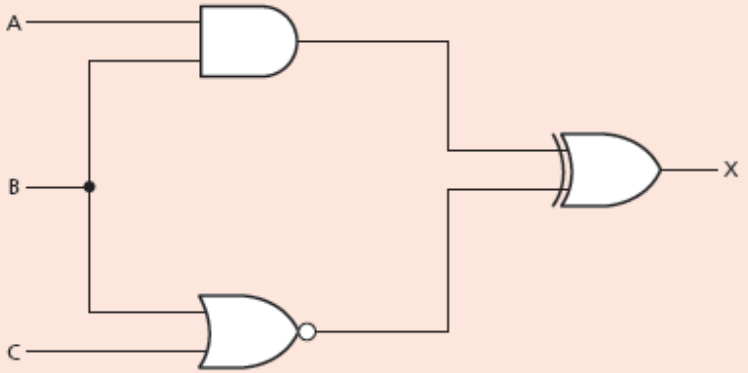
e



▲ Figure 10.18

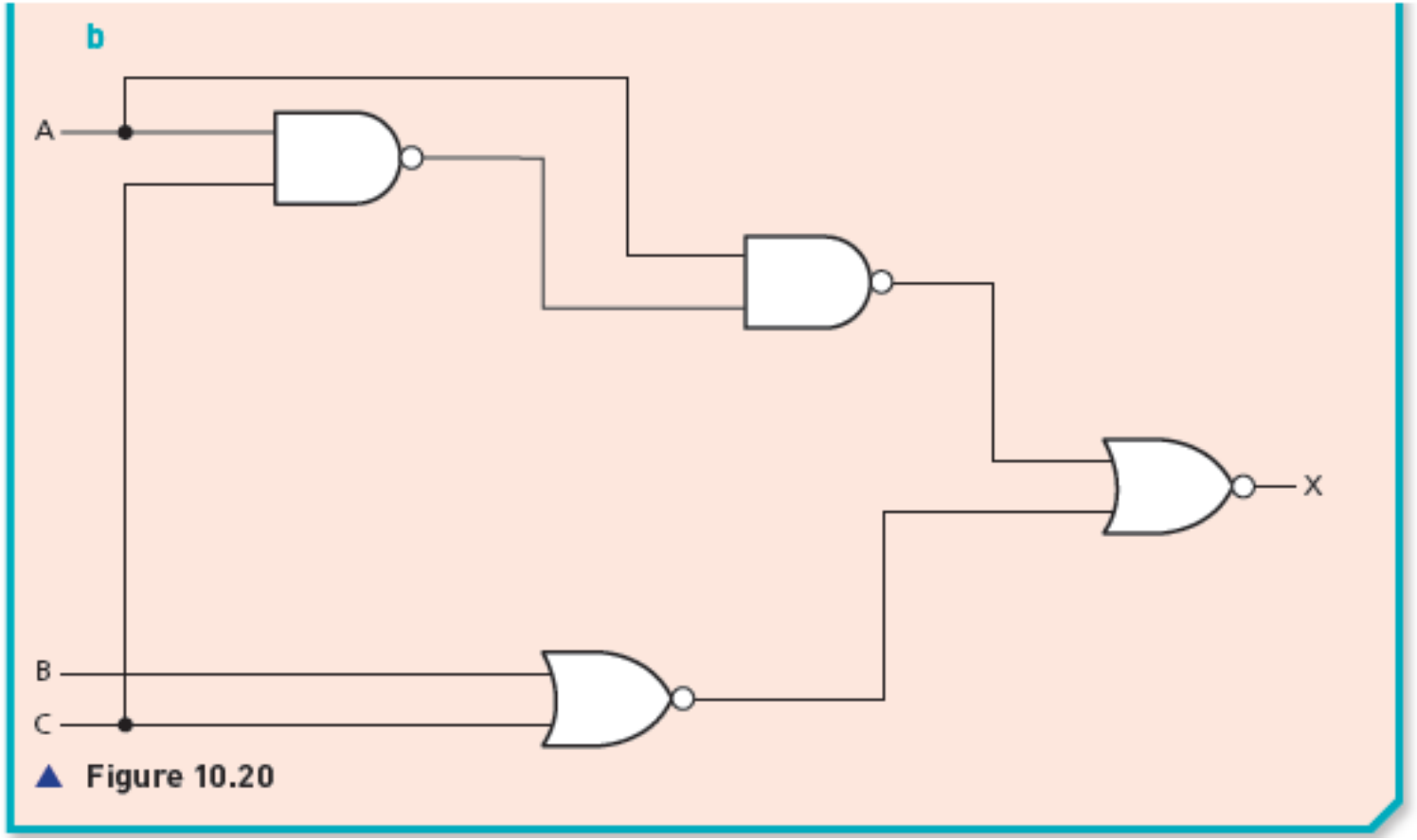
2 Write logic expressions for the following logic circuits:

a



▲ Figure 10.19

Activity p.366



▲ Figure 10.20

Activity p.370

Activity 10.3

1 Produce:

i a truth table

ii a logic circuit

from the following logic expression:

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

2 Produce:

i a truth table

ii a logic circuit

from the following logic expression:

(A XOR B) OR ((B NOR C) AND B)

3 Produce:

i a logic expression

ii a logic circuit

from the following truth table:

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

4 Write down a logic expression for **each** of the following truth tables:

a

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	1
1	1	0	0
1	1	1	0

b

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

5 a Write down a logic expression corresponding to the following truth table:

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

b Show that the following logic expression produces the same output as your answer to part a above:

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

Sources

Watson, **David**, Williams, Helen. Cambridge **IGCSE computer science**

https://craigndave.org/videos/cambridge-igcse-topic-10-creating-logic-circuits/

https://www.youtube.com/@mrbulmerslearningzone

https://www.savemyexams.com/