MODULE Q BOOLEAN LOGIC · Q6

Logic expressions: writing them and drawing them

Original practice questions · 22 marks · ~25 minutes · Cambridge 0478 syllabus 10.1, 10.2, 10.3(a), 10.3(b), 10.3(c)

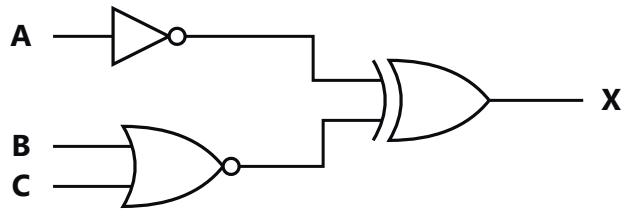
Name _____ Date _____

Instructions. Answer all questions in the spaces provided. The marks for each part are shown in brackets [ ]. The total for this worksheet is **22 marks**. Logic expressions may use NOT, AND, OR, NAND, NOR and XOR. Draw logic circuits in pencil with the standard logic gate symbols. All scenarios are made up.

1

Total: 3 marks

This logic circuit is part of the control system in a commercial washing machine.



(a) Write the logic expression for the logic circuit. Do not attempt to simplify the logic expression. **[3]**

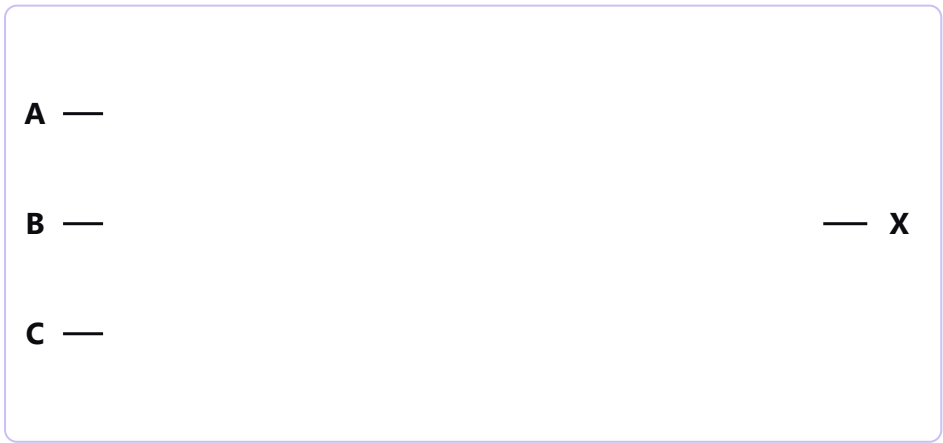
2

Total: 4 marks

Consider the logic expression:

```
X = ((NOT A) AND B) NOR (A XOR C)
```

(a) Draw a logic circuit for this logic expression. **[4]**
Each logic gate must have a maximum of **two** inputs.
Do not simplify this logic expression.



3 **Total: 3 marks**

A logic circuit gives this truth table.

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	0
1	1	0	1
1	1	1	0

(a) Write a logic expression for this truth table. You do not need to simplify it. **[3]**

4 **Total: 3 marks**

A grain silo has two level sensors fitted at the same height. A fault light (X) shows when the two sensors disagree. The system uses the inputs in the table.

Input	Binary value	Meaning
A	1	Level sensor A detects grain
	0	Level sensor A does not detect grain
B	1	Level sensor B detects grain
	0	Level sensor B does not detect grain
C	1	Conveyor is running
	0	Conveyor is not running

The fault light comes on (X = 1) when:

- one level sensor detects grain but the other does not
- **and** the conveyor is not running.

(a) Write the logic expression for this problem statement. Do not attempt to simplify the logic expression. **[3]**

5 **Total: 5 marks**

Two logic expressions use the same inputs:

```
X = NOT (A OR B)
Y = (NOT A) OR B
```

(a) Complete the truth table for **both** logic expressions. **[4]**

A	B	X	Y	Working space
0	0			
0	1			
1	0			
1	1			

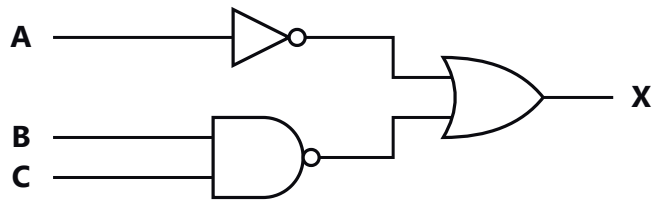
(b) Identify the **single** logic gate that gives the same output as X. **[1]**

6 **Total: 4 marks**

A technician was asked to draw a logic circuit for this logic expression:

```
X = (B NAND C) AND (NOT A)
```

This is the circuit the technician drew. It contains **one** error.



(a) Identify the error in the circuit and describe how to correct it. **[2]**

(b) Write the logic expression for the circuit **exactly as the technician drew it**. **[2]**

Total for this worksheet: 22 marks