Logical operations

- Logical operators Use AND, OR, NOT and XOR logical operators, combinations of these, and their application in appropriate truth tables to solve problems.
- Boolean logic Simplify Boolean expressions using Boolean identities and rules.

2014 – truth table

(b) Complete the following truth table, for the logical OR operation, by writing either **False** or **True** in the last column. [4]

A	B	A OR B
True	True	
True	False	
False	True	
False	False	

2015 – truth table

(a) Complete the following *truth table*, for the logical **AND** operation, by writing **0** or **1** in the last column. *The first row has been completed for you.* [3]

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

2016– truth table

Complete the following *Truth Table*. [4]

A	B	A OR B	NOT (A OR B)
1	1		
1	0		
0	1		
0	0		

Sample / 2017 – truth table

(a) (i) Complete the following truth table. [4]

A	B	$\overline{B}$	$A.B$	$A.\overline{B}$	$B + (A.\overline{B})$
1	1				
1	0				
0	1				
0	0				

(ii) Use this truth table to simplify the expression. [1]

$$B + (A.\overline{B})$$

.....

.....

.....

2018

(a) Complete the following truth table. [4]

P	Q	$P + Q$	$P.Q$	$\overline{P.Q}$	$\overline{P.Q} + (P + Q)$
1	1				
1	0				
0	1				
0	0				

(b) Draw a truth table for the expression: [4]

$$X = A.B + \overline{A}.B$$

Mark scheme on next slide

2018

Mark scheme

P	Q	$P+Q$	$P.Q$	$\overline{P.Q}$	$\overline{P.Q}+(P+Q)$
1	1	1	1	0	1
1	0	1	0	1	1
0	1	1	0	1	1
0	0	0	0	1	1

One mark for each of the following correct columns:

- $P+Q$
- $P.Q$
- $\overline{P.Q}$
- $\overline{P.Q}+(P+Q)$

Sample / 2017 – truth table

Draw a truth table for the expression:

$$X = A.B + A.\overline{B}$$

Mark scheme on next slide

Sample / 2017– truth table

Mark scheme

One mark for each correct row (table can contain more or fewer columns)

A	B	$A.B$	$\overline{B}$	$A.\overline{B}$	$A.B + A.\overline{B}$
1	1	1	0	0	1
1	0	0	1	1	1
0	1	0	0	0	0
0	0	0	1	0	0

(i) Using the following identities:

$$P.1 = P$$

$$P.Q + P.R = P.(Q + R)$$

$$P + \overline{P} = 1$$

simplify the Boolean expression:

$$X = A.B + A.\overline{B}$$

2015

(b) Below are three 8-bit registers labelled **A**, **B** and **C**.

Carry out a logical **AND** operation on the bits in the registers **A** and **B** and write the result in register **C**. [2]

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

(c) Describe the result produced in register **C** of performing a logical **AND** operation using the bit pattern in register **B** on any bit pattern in register **A**. [2]

.....

.....

.....

(b) A heater is controlled by an embedded system.

- There is a power button (A) to turn the power going to the heater on or off.
- A temperature sensor (B) will turn the heater on when the temperature is below 20°C, provided the power button has been left on.
- A manual override switch (C) will turn the heater on, regardless of the temperature, provided the power button has been left on.

Construct a logic statement to represent this situation, using the symbols A, B, and C.

[3]

.....

.....

.....

How do OR and XOR logic gates differ? [1 Mark]

☐ An OR gate always outputs 0 no matter what the inputs whereas an XOR outputs a 1 if one or more of the inputs is a 1

☐ There is no difference

☐ An OR gate outputs a 1 if one or more of the inputs is a 1 whilst an XOR outputs a 1 if only one (not both) of the inputs is a 1