

GCE AS LEVEL – COMPUTER SCIENCE UNIT 1 QUESTION PACK

2500U10-1 · 2015 spec Unit 1 Topic 1 · AS unit, first sat 2017, 100 marks, 2h paper

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COMPUTER SCIENCE – UNIT 1 · Logic Gates, Truth Tables & Boolean Algebra

Topic 1.1 – Boolean logic, truth tables and algebraic simplification

AND, OR, NOT, XOR, NAND and NOR gates, drawing and completing truth tables, applying Boolean identities (De Morgan's, distributive, absorption) to simplify expressions, and converting expressions to logic-gate circuits.

2015 specification · current

Estimated time for entire question pack: ~1 h 27 min*Derived from the Unit 1 pace of ~1.2 min/mark, padded for written-prose answers (58 marks over 11 questions).**You are advised to **not** attempt to complete all of this in one sitting.*

ABOUT THIS QUESTION PACK

This is a **comprehensive topic question pack**, not a single mock paper. It contains every question from the WJEC AS Unit 1 papers (Summer 2017 – Summer 2024, COVID gap) that maps onto Topic 1.1 of the 2015 specification.

Questions are ordered by source paper date.

INSTRUCTIONS

Use black ink or black ball-point pen. Show all working. A calculator is allowed where useful.

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Q	Source	Max	Mark
1	S17 Q1	2	
2	S17 Q6	6	
3	S18 Q1	4	
4	S18 Q4	8	
5	S19 Q5	3	
6	S19 Q8	6	

Q	Source	Max	Mark
7	S22 Q9	5	
8	S23 Q3	3	
9	S23 Q8	7	
10	S24 Q1	6	
11	S24 Q3	8	
Total		58	

Logic Gates, Truth Tables & Boolean Algebra – what the spec asks

WJEC GCE AS Computer Science (from 2015) · Unit 1: Fundamentals of Computer Science · Topic 1.1.

Logic gates

- AND, OR, NOT gates; NAND, NOR, XOR as derived gates.
- Symbols (BS / ANSI distinctive shape) and truth tables for each gate.
- NAND and NOR are functionally complete – can build any logic from them alone.
- XOR = output 1 when inputs differ (exclusive OR).

Truth tables

- 2-input table has 4 rows; 3-input table has 8 rows; n inputs $\Rightarrow 2^n$ rows.
- Fill input combinations in standard binary-count order.
- Build output column-by-column for each sub-expression, then combine.
- Compare resulting columns of two expressions to test for equivalence.

Boolean identities

- $A \cdot A = A$ $A + A = A$ (idempotent).
- $A \cdot 0 = 0$ $A + 1 = 1$ $A \cdot 1 = A$ $A + 0 = A$.
- $A + A \cdot B = A$ (absorption); $A \cdot (A + B) = A$.
- De Morgan: $\text{NOT}(A \cdot B) = \text{NOT } A + \text{NOT } B$ $\text{NOT}(A + B) = \text{NOT } A \cdot \text{NOT } B$.

Simplification strategy

- Look for common factors (distributive law): $A \cdot B + A \cdot C = A \cdot (B + C)$.
- Apply absorption to drop redundant terms.
- Use De Morgan's to push NOTs inside or to convert $\text{AND} \Leftrightarrow \text{OR}$.
- Show each step on a new line citing the law used.

Karnaugh maps (when used)

- K-map cells labelled by Gray code so adjacent cells differ by one bit.
- Group adjacent 1s in powers of two (1, 2, 4, 8) – bigger groups simplify more.
- Wrap around left \leftrightarrow right and top \leftrightarrow bottom edges.
- Each group becomes a product term in the SOP simplified expression.

Circuit diagrams

- Draw gates left to right, inputs on left, output on right.
- Inverters shown as bubbles on inputs or as separate NOT gates.
- Bus wires for shared inputs, junction dots for connections.
- Label inputs and intermediate signals clearly.

Logic Gates, Truth Tables & Boolean Algebra in one page

Quick-reference notes – revisit before each question.

De Morgan's laws

$$\text{NOT}(A \cdot B) \equiv \text{NOT } A + \text{NOT } B$$

$$\text{NOT}(A + B) \equiv \text{NOT } A \cdot \text{NOT } B$$

Used to push negations across AND/OR or convert one form to the other.

Absorption

$$A + A \cdot B \equiv A \quad (\text{A absorbs } A \cdot B)$$

$$A \cdot (A + B) \equiv A$$

Useful first step in many simplifications.

Truth-table size

n inputs $\Rightarrow 2^n$ rows. 2 in \rightarrow 4 rows, 3 in \rightarrow 8 rows, 4 in \rightarrow 16 rows. Always include every combination.

Simplify checklist

1. Expand brackets (distributive).
2. Use $A \cdot A' = 0$, $A + A' = 1$.
3. Apply absorption.
4. Apply De Morgan if needed.
5. Show each step with its law.

XOR identity

$$A \text{ XOR } B \equiv A \cdot B' + A' \cdot B \equiv (A + B) \cdot (A \cdot B)'$$

Returns 1 when exactly one of A, B is 1.

Gate equivalences

NAND-only: $A \cdot B \equiv (A \text{ NAND } B) \text{ NAND } (A \text{ NAND } B)$

NOR-only: $A + B \equiv (A \text{ NOR } B) \text{ NOR } (A \text{ NOR } B)$

Useful when only one gate type is allowed.

Examiner only

Answer all questions.

1. Complete the following truth table. [4]

A	B	C	A OR C	B AND C	(A OR C) XOR (B AND C)	NOT ((A OR C) XOR (B AND C))
0	0	0				
0	1	0				
1	0	0				
1	1	0				
0	0	1				
0	1	1				
1	0	1				
1	1	1				

2. State the use of the following network protocols:

(a) DHCP [1]

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(b) SMTP [1]

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.....

.....

(c) HTTP [1]

.....

.....

.....

Examiner only

5. Give the simplest Boolean expression for each truth table.

(a)

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

[1]

.....

.....

.....

.....

(b)

Input		Output
P	Q	R
0	0	1
1	0	0
0	1	0
1	1	0

[1]

.....

.....

.....

.....

(c)

Input		Output
X	Y	Z
0	0	1
1	0	0
0	1	0
1	1	1

[1]

.....

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.....

.....

3. The following data is stored in an 8 bit register:

1	0	1	1	1	0	0	0
---	---	---	---	---	---	---	---

Demonstrate how the state of the most significant bit can be determined using a logical operation.

[3]

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Examiner only

Answer **all** questions.

1. Draw a truth table for the following Boolean expression:

[6]

$$X = P \oplus Q + R.(P + \overline{Q})$$

Examiner
only



END OF QUESTION PACK

11 questions · 58 marks · ~1 h 27 min

Source: WJEC AS Computer Science Unit 1 (2500U10-1), Summer 2017–2024, COVID gap
Curated for WJEC Computer Science 2015 spec AS Unit 1 – Topic 1 (1.1)

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