MODULE Q · OCR J277 2.4.1 · CAMBRIDGE 0478 10.1, 10.2, 10.3

Boolean logic

Logic gates, **truth tables**, **logic circuits**, **logic expressions** and **problem statements**. 1 = true / on, 0 = false / off. **OCR J277: skip card 02** and the IGCSE-only rows; it uses AND, OR and NOT only. **Cambridge 0478: every card**, without the GCSE-only rows. Spec versions as checked in November 2026.

01 AND, OR and NOT (Q1) · both boards

Gate Takes binary inputs (1 = true / on, 0 = false / off); gives one binary output.

AND  1 only if both inputs are 1. D shape.

OR  1 if either input is 1, or both. Curved shield.

NOT  One input; output is the opposite. Triangle + circle.

GCSE only Conjunction (AND), disjunction (OR), negation (NOT). T/F or v for OR accepted. Only these 3 gates.

IGCSE only NOT has one input; every other gate exactly two.

02 NAND, NOR and XOR (Q2) IGCSE only

NAND  NOT AND: 0 only when both inputs are 1.

NOR  NOT OR: 1 only when both inputs are 0.

XOR  Also EOR: 1 when the inputs are different.

Words "Not both" = NAND. "Neither ... nor" = NOR. "Either ... but not both" = XOR.

OCR Not on J277: GCSE students skip Q2.

03 Single-gate truth tables (Q3) · both boards

Truth table Output for every possible combination of inputs.

Rows 2^n for n inputs: 1 input = 2 rows; 2 inputs = 4 rows. Order 00, 01, 10, 11.

AND / OR AND 0, 0, 0, 1. OR 0, 1, 1, 1. NOT: 0 → 1, 1 → 0.

IGCSE only NAND 1, 1, 1, 0. NOR 1, 0, 0, 0. XOR 0, 1, 1, 0. Never more than 4 rows for one gate.

Identify 0, 1, 1, 1 is OR (not XOR: XOR gives 0 for 11).

04 Circuits with more than one gate (Q4) · both boards

Circuit One gate's output is another gate's input. OCR: "logic diagram".

Trace Left to right, one gate at a time; label in-between outputs (D, E).

Example P = (NOT A) AND (B OR C). A = 0, B = 1, C = 0: D = 1, E = 1, P = 1.

NOT Inverts only the one line it sits on.

GCSE only AND, OR, NOT only; complete or edit a part-drawn diagram.

IGCSE only May include NAND, NOR, XOR; max 3 inputs, 1 output.

05 Truth tables for circuits (Q5) · both boards

Rows 3 inputs: 2^3 = 8 rows. A 0000 1111, B 0011 0011, C 0101 0101.

Working One column per in-between gate; fill one column at a time, then the output.

Example P = (NOT A) AND (B OR C): P column 0, 1, 1, 1, 0, 0, 0, 0.

Check Every combination once; every row has an output.

GCSE only Truth tables for given scenarios; T/F accepted.

IGCSE only From a problem statement, expression or circuit; "Working space" column.

06 Logic expressions (Q6) · both boards

Expression A circuit in words, e.g. P = (A AND B) OR (NOT C). Brackets show the order.

Circuit → Start at the output gate; work back, bracketing each gate's inputs.

→ Circuit Draw the innermost brackets first; feed them into the next gate.

NOT Applies to what follows it: NOT (A OR B) ≠ (NOT A) OR B (try A = 0, B = 1).

GCSE only AND, OR, NOT only; other valid notation accepted.

IGCSE only Also from a statement or truth table: AND the inputs in each 1-row (NOT on 0s), OR the terms. No simplifying.

07 Problem statement to circuit (Q7) · both boards

Inputs Name each input and the one output; what do 1 and 0 mean?

Words "and" = AND, "or" = OR, "not" / opposite of an input's 1 = NOT.

Method Write the expression first; one gate per operator; inner parts first; test rows.

Example Drinks machine: V = (S AND (NOT E)) AND (NOT W). Only S = 1, E = 0, W = 0 gives 1.

GCSE only AND, OR, NOT for given scenarios; no limit on gates.

IGCSE only Draw as stated, no simplifying; max 3 inputs; "either but not both" = XOR.

✓ Quick check · both boards

A=1, B=1 AND 1 · OR 1 · NOT A 0

A=0, B=1 AND 0 · OR 1 · NOT A 1

IGCSE only A=1, B=1: NAND 0 · NOR 0 · XOR 0

IGCSE only A=0, B=1: NAND 1 · NOR 0 · XOR 1

01
NOT needs its **small circle**. A circle on AND or OR makes **NAND or NOR**.

02
Draw the gate **shape**, never a box with the name written in it.

03
Count the inputs up in **binary**: 4 rows for 2 inputs, **8 rows** for 3.

04
IGCSE: **two inputs** per gate (NOT one), and **do not simplify**.