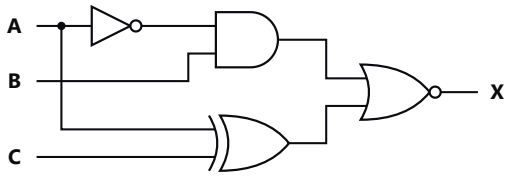
MODULE Q BOOLEAN LOGIC · Q6

Logic expressions: writing them and drawing them: mark scheme

22 marks · Cambridge 0478 syllabus 10.1 (gate symbols), 10.2 (gate functions), 10.3(a)(ii) (circuit from a logic expression), 10.3(b)(ii) (truth table from a logic expression), 10.3(c)(i)-(iii) (logic expression from a problem statement, logic circuit or truth table)

How to use. One mark per bullet point up to the maximum shown. **//** separates alternative answers. Words in (brackets) are not needed for the mark. Logic expressions use NOT, AND, OR, NAND, NOR and XOR (accept EOR for XOR); capitals are not required. Accept any expression that gives the same output as the required one for every input, unless the guidance says otherwise. Credit any other valid answer that shows the same understanding.

QUESTION	ANSWER	MARKS	GUIDANCE
1(a) 0478 10.3(c) (ii), 10.1	One mark for each correct part: • `NOT A` • `B NOR C` • `XOR` joining the two parts Example: `X = (NOT A) XOR (B NOR C)`	**3**	Accept `NOT (B OR C)` for `B NOR C`. Brackets round `NOT A` not needed. The XOR mark needs both parts bracketed or clearly grouped as two separate parts. Do not accept `A NOT`. Do not accept `B OR C` (circle missed) for the second mark. `X =` not required.
2(a) 0478 10.3(a) (ii)	One mark for each correct logic gate with the correct inputs: • NOT gate with input A • AND gate with inputs NOT A and B • XOR gate with inputs A and C • NOR gate with inputs from the AND gate and the XOR gate 	**4**	Gates must use the 0478 symbols. Each logic gate must have a maximum of two inputs. A must reach both the NOT gate and the XOR gate (a branch from the A line, or A drawn twice, are both fine). Do not credit a gate drawn as a box with its name written in. A simplified circuit that is not drawn as given: credit only the gates that match the expression.
3(a) 0478 10.3(c) (iii)	One mark for each: • `(NOT A AND B AND C)` • `(A AND B AND NOT C)` • both terms joined with `OR` Example: `X = (NOT A AND B AND C) OR (A AND B AND NOT C)`	**3**	The OR mark needs at least one correct term. Accept the terms in either order and any extra brackets, e.g. `((NOT A) AND B) AND C`. Accept any correct equivalent expression for full marks, e.g. `B AND (A XOR C)`. An extra term for a row with output 0: max 2.

QUESTION	ANSWER	MARKS	GUIDANCE
4(a) 0478 10.3(c)(i)	One mark for each: • `A XOR B` • `NOT C` • both parts joined with `AND` Example: `X = (A XOR B) AND (NOT C)`	**3**	Accept the parts in either order. Accept `(A OR B) AND NOT (A AND B)` or `(A AND NOT B) OR (NOT A AND B)` for `A XOR B`. `A OR B` in place of XOR loses the first mark. Do not accept `C NOT`.
5(a) 0478 10.3(b)(ii)	<table><tr><th>A</th><th>B</th><th>X</th><th>Y</th></tr><tr><td>0</td><td>0</td><td>1</td><td>1</td></tr><tr><td>0</td><td>1</td><td>0</td><td>1</td></tr><tr><td>1</td><td>0</td><td>0</td><td>0</td></tr><tr><td>1</td><td>1</td><td>0</td><td>1</td></tr></table>	**4**	8 correct outputs: 4 marks; 6 or 7 correct: 3 marks; 4 or 5 correct: 2 marks; 2 or 3 correct: 1 mark. Working space not marked.
5(b) 0478 10.2	• NOR	**1**	Accept NOR drawn as its gate symbol. Do not accept NOT OR // OR then NOT (two gates, the question asks for a single gate). Do not accept NAND.
6(a) 0478 10.3(c)(ii), 10.1	One mark for each: • the gate giving output X // the last gate is an OR gate • replace it with an AND gate	**2**	The first mark needs the correct gate to be identified (the last / output gate, or the OR gate). The second mark needs AND to be named or drawn. Do not credit changing the NOT gate or the NAND gate.
6(b) 0478 10.3(c)(ii)	One mark for each: • `(B NAND C)` and `NOT A` both correct • joined with `OR` Example: `X = (B NAND C) OR (NOT A)`	**2**	Accept `NOT (B AND C)` for `B NAND C`. Accept the parts in either order. The intended expression `(B NAND C) AND (NOT A)` = max 1. Do not accept `B AND C` (circle missed) for the first mark.

Total: 22 marks