MODULE Q BOOLEAN LOGIC · Q3

Truth tables for single gates: mark scheme

21 marks · OCR J277 specification 2.4.1 (truth tables for each logic gate; recognition of each gate symbol; create, complete or edit truth tables for given scenarios; applying logical operators in truth tables to solve problems)

How to use. 1 mark per bullet up to the maximum shown. **/** separates alternative words or answers. Words in (brackets) are not needed for the mark. **...** means the mark depends on the point before it. Allow other valid notation for truth table values, e.g. T/F for 1/0 (J277 2.4.1). Credit any other valid answer that shows the same understanding.

<table>
<tr><th>QUESTION</th><th>ANSWER</th><th>MARKS</th><th>GUIDANCE</th></tr>
<tr><td>1(a)
J277 2.4.1</td><td>The output (of a logic gate / circuit) for every possible combination of inputs</td><td>1</td><td>Allow “all possible inputs and their outputs”.
Do not allow “the inputs and outputs” without the idea of all combinations / possibilities.</td></tr>
<tr><td>1(b)
J277 2.4.1</td><td>4 (rows)
Each input can be 0 or 1 / has 2 possible values ... so there are 2 × 2 / 2^2 = 4 combinations (and each needs a row)</td><td>2</td><td>Mark each point on its own.
Allow “00, 01, 10 and 11 are the only combinations” for mark 2.
Do not allow “because there are two inputs” on its own.</td></tr>
<tr><td>2(a)
J277 2.4.1</td><td>Gate 1 (AND): 1 mark for rows 1–2 correct, 1 mark for rows 3–4 correct
Gate 2 (OR): 1 mark for rows 1–2 correct, 1 mark for rows 3–4 correct
Gate 3 (NOT): 1 mark for both rows correct
Gate 1 (AND)
<table><tr><th>A</th><th>B</th><th>P</th></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>0</td></tr><tr><td>1</td><td>0</td><td>0</td></tr><tr><td>1</td><td>1</td><td>1</td></tr></table>Gate 2 (OR)
<table><tr><th>A</th><th>B</th><th>P</th></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>1</td></tr><tr><td>1</td><td>0</td><td>1</td></tr><tr><td>1</td><td>1</td><td>1</td></tr></table>Gate 3 (NOT)
<table><tr><th>A</th><th>P</th></tr><tr><td>0</td><td>1</td></tr><tr><td>1</td><td>0</td></tr></table></td><td>5</td><td>Max 2 for gate 1, max 2 for gate 2, max 1 for gate 3.
Allow T/F, True/False or Yes/No in place of 1/0.
Mark each pair of rows on its own; the outputs must match the symbol shown.</td></tr>
</table>

QUESTION	ANSWER	MARKS	GUIDANCE
3(a) J277 2.4.1	J: OR K: AND L: NOT	**3**	Allow disjunction for OR, conjunction for AND, negation for NOT. Allow a correct gate symbol drawn in place of the name.
4(a) J277 2.4.1	OR (gate)	**1**	Allow disjunction. Allow a correct OR symbol. Do not allow "either" on its own.
4(b) J277 2.4.1	1 mark for rows 1–2 correct, 1 mark for rows 3–4 correct H F E 0 0 0 0 1 1 1 0 1 1 1 1	**2**	Allow T/F in place of 1/0. FT from an incorrect gate in (a) is **not** allowed: the table must match the scenario.
4(c) J277 2.4.1	H = 0 and F = 0 (both inputs 0)	**1**	Allow "neither sensor is on / the room is not too hot and no fumes are detected". Allow FT from the candidate's table in (b) only if it has exactly one row with E = 0.
5(a) J277 2.4.1	Error 1: Row 3 / the third row is a repeat of row 2 (0 1) / the input combination 1 0 is missing … … row 3 should be A = 1, B = 0 (with output 0) Error 2: Row 4 / the row where A = 1 and B = 1 has the wrong output / output 0 … … the output should be 1	**4**	1 mark for identifying each error, 1 mark for its correction. For error 1 allow "row 2 should be 1 0" (the table is then still complete and correct). Allow the errors in either order. Do not allow "row 3 output should be 1" (A = 0, B = 1 gives 0 for AND).
6(a) J277 2.4.1	Max 2 from: AND gives 0 … because AND only outputs 1 when both inputs are 1 / B is 0 OR gives 1 … because OR outputs 1 when at least one input is 1 / A is 1	**2**	Each mark needs the output **and** the reason. Allow "AND needs both, OR needs either / one" with the correct outputs stated. Credit any other valid answer that shows the same understanding.

Total: 21 marks