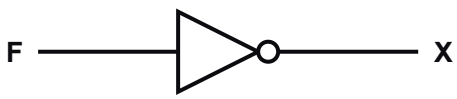
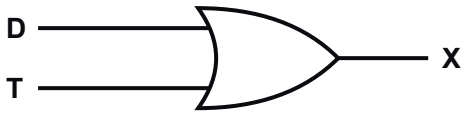
MODULE Q BOOLEAN LOGIC · Q1

Logic gates: AND, OR and NOT: mark scheme

20 marks · Cambridge 0478 syllabus 10.1 (standard symbols), 10.2 (functions of logic gates), 10.3 (circuits and expressions from a problem statement)

How to use. One mark per bullet point unless stated, up to the max shown. **//** separates alternative answers. Words in (brackets) are not needed for the mark. Logic circuits: the gate must be drawn with the standard 0478 symbol; a box with the gate's name written in it scores 0 for that gate. A NOT gate must have its small circle; an AND or OR gate must not have one. NOT has one input; AND and OR have exactly two inputs.

QUESTION	ANSWER	MARKS	GUIDANCE
1(a) 0478 10.1	One mark for each correct gate: Symbol 1: NOT Symbol 2: AND Symbol 3: OR	**3**	Do not accept NAND, NOR or XOR.
2(a) 0478 10.2	One mark for each correct row: Output 1 only when both inputs are 1: AND Opposite of its single input: NOT Output 0 only when both inputs are 0: OR	**3**	More than one gate written in a row: 0 for that row.
3(a) 0478 10.2	<table><tr><th>A</th><th>B</th><th>A AND B</th><th>A OR B</th></tr><tr><td>0</td><td>0</td><td>0</td><td>0</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>1</td></tr><tr><td>1</td><td>1</td><td>1</td><td>1</td></tr></table> One mark: A AND B rows 1-2 (0, 0) One mark: A AND B rows 3-4 (0, 1) One mark: A OR B rows 1-2 (0, 1) One mark: A OR B rows 3-4 (1, 1)	**4**	Each mark needs both outputs in that pair correct.
4(a) 0478 10.3(c)(i)	X = NOT F	**1**	Accept X = NOT(F). Do not accept "X = F NOT" or "X = F".
4(b) 0478 10.1, 10.3(a)(i)	Correct NOT symbol: triangle with a small circle at the output F as its only input and X as its output (no other gates) 	**2**	Triangle without the circle = 0 for the first mark. Second mark lost if any extra gate is drawn.
5(a) 0478 10.3(c)(i)	X = D OR T	**1**	Accept X = T OR D, X = (D OR T). Do not accept AND.

QUESTION	ANSWER	MARKS	GUIDANCE
5(b) 0478 10.1, 10.3(a)(i)	Correct OR symbol (curved back, pointed front, no circle) D and T as its two inputs and X as its output (no other gates)  	**2**	An XOR symbol (extra curved line at the inputs), a NOR symbol (circle at the output) or an AND symbol = 0 for the first mark. The second mark needs the first.
5(c) 0478 10.2	1	**1**	Accept "the buzzer sounds" // On // TRUE.
5(d) 0478 10.2	Any three from: AND only outputs 1 when both inputs are 1 A correct example where only one input is 1: D = 1, T = 0 (door open, temperature safe) // D = 0, T = 1 (door closed, temperature too high) ... ... AND would give X = 0 so the buzzer would not sound when it should // OR gives 1 for this combination The buzzer must sound when either condition happens on its own // when at least one input is 1	**3**	Max 3. The third bullet needs a correct example. Accept the example in words. An example with D = 1, T = 1 or D = 0, T = 0 earns no example mark (AND and OR give the same output). "AND is wrong" with no reason = 0. Credit any other valid explanation.

Total: 20 marks