MODULE Q BOOLEAN LOGIC · Q4

Reading logic circuits: mark scheme

21 marks · Cambridge 0478 syllabus 10.1 (logic gate symbols), 10.2 (functions of NOT, AND, OR, NAND, NOR, XOR), 10.3(b)(iii) (complete a truth table from a logic circuit) and 10.3(c)(ii) (write a logic expression from a logic circuit)

How to use. One mark per bullet point up to the max shown. **//** separates alternative answers; **/** separates alternative words. Words in (brackets) are not needed for the mark. Credit any other valid answer that shows the same understanding. Accept T/F for 1/0. Accept EOR for XOR.

QUESTION	ANSWER	MARKS	GUIDANCE
1(a) 0478 10.1	Gate 1: NOR Gate 2: XOR // EOR	**2**	One mark each. Do not accept OR for gate 1 or OR for gate 2.
1(b) 0478 10.2, 10.3(b)(iii)	P = 1 X = 0	**2**	One mark each. 0 NOR 0 = 1; 1 XOR 1 = 0. Follow through: if P is wrong, X = P XOR 1 (the opposite of their P) scores the second mark.
2(a) 0478 10.3(b)(iii)	Output column X: A B C X 0 0 0 1 0 0 1 1 0 1 0 1 0 1 1 0 1 0 0 0 1 0 1 0 1 1 0 1 1 1 1 0	**4**	4 marks for 8 correct outputs; 3 marks for 6 or 7 correct; 2 marks for 4 or 5 correct; 1 mark for 2 or 3 correct. The working space is not marked. X = (A NOR B) OR (B AND NOT C).
3(a) 0478 10.3(c)(ii)	X = (A XOR B) NOR (NOT C) One mark for each correct part: A XOR B NOT C ... NOR ... joining the two parts (with brackets showing the order)	**3**	Accept EOR for XOR. Accept X = (A XOR B) NOR NOT C. Do not accept a simplified expression for the third mark. Do not accept C NOT for NOT C.
4(a) 0478 10.2, 10.3(b)(iii)	P = 0 Q = 1	**2**	One mark each. Circuit 1: 1 OR 1 = 1, NOT gives 0. Circuit 2: NOT A = 0, 0 OR 1 = 1. The NOT gate only inverts the one signal on its line.

QUESTION	ANSWER	MARKS	GUIDANCE
4(b) 0478 10.2	NOR	**1**	Do not accept NAND or OR.
5(a) 0478 10.3(b)(iii)	0 // fan off	**1**	Accept False.
5(b) 0478 10.2, 10.3(b)(iii)	One mark each: the dust level is high // D = 1 … … or the workshop is too hot // or T = 1 // or both and the maintenance switch is off // M = 0	**3**	The first two marks need the "or" link: an answer that needs both D and T to be 1 scores max 1 of the first two marks. Do not accept "maintenance switch on" for the third mark. "D or T (or both) is 1 and M is 0" scores 3.
6(a) 0478 10.2, 10.3(b)(iii)	Max 3: the engineer is not correct, with a counter-example: A = 0, B = 1 and C = 1 A XOR B = 1 (because A and B are different) B NAND C = 0 (because B and C are both 1) … so X = 1 AND 0 = 0	**3**	"Not correct" with no reason scores 0. For full marks the answer must give, or clearly describe, A = 0, B = 1, C = 1 (the only case where A and B differ and X = 0). Credit working written on the circuit. "The engineer is correct" scores 0.

Total for this mark scheme: 21 marks