MODULE Q BOOLEAN LOGIC · Q4

Reading logic circuits: mark scheme

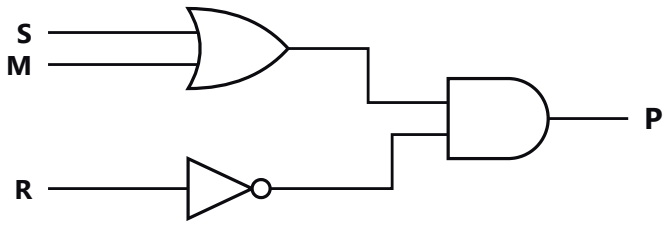
21 marks · OCR J277 spec 2.4.1: simple logic diagrams using AND, OR and NOT; truth tables; combining Boolean operators; working with more than one gate in a logic diagram; creating, completing or editing logic diagrams for given scenarios

How to use. 1 mark per bullet up to the maximum shown. **/** separates alternative answers. Words in (brackets) are not needed for the mark. Credit any other valid answer that shows the same understanding. T/F (True/False) may be used in place of 1/0. Drawn gates are marked on shape, not label: a NOT gate must have its circle; AND and OR gates must not. A box with the gate name written inside scores 0.

QUESTION	ANSWER	MARKS	GUIDANCE
1(a) J277 2.4.1	Gate 1: AND Gate 2: OR	**2**	Accept conjunction for AND and disjunction for OR.
1(b) J277 2.4.1	X = 0 P = 1	**2**	1 mark each. Accept False / True. A = 1 AND B = 0 gives 0; 0 OR C (1) gives 1.
2(a) J277 2.4.1	1 mark per correct row (D, E, F and P all correct): A B C D E F P 0 1 0 1 1 0 1 1 1 0 0 0 0 0 1 0 1 0 0 1 1 0 0 1 1 0 0 0	**4**	D = NOT A; E = D AND B; F = A AND C; P = E OR F. A row with any wrong value scores 0 for that row. Accept T/F.
3(a) J277 2.4.1	P = 1 Q = 0	**2**	1 mark each. Circuit 1: A AND B = 0, then NOT gives 1. Circuit 2: NOT A = 0, then 0 AND B gives 0. The NOT gate only changes the one signal it is placed on.
4(a) J277 2.4.1	0 / heater off	**1**	Accept False.
4(b) J277 2.4.1	1 mark each: the door is closed / D = 1 the timer is running / T = 1 the oven is not too hot / K = 0	**3**	All three conditions must be needed together (joined by "and"); if the answer says any one condition is enough, max 1. Do not accept "K = 1" or "the oven is hot" for the third mark. "When D, T and NOT K are all 1" scores 3.

QUESTION	ANSWER	MARKS	GUIDANCE
5(a) J277 2.4.1	AND gate drawn in the box, with S and the output of the NOT gate as its two inputs and its output going to the OR gate	**1**	Shape marked, label ignored. Do not accept an AND gate with a circle (that is not an AND gate) or an OR gate.
5(b) J277 2.4.1	1 mark each: S and M are the inputs to an OR gate R is the input to a NOT gate the outputs of the OR gate and the NOT gate are the inputs to an AND gate, whose output is P *P = (S OR M) AND (NOT R). An example answer is drawn below the table.*	**3**	Accept any logically equivalent diagram that uses only AND, OR and NOT gates, e.g. (S AND NOT R) OR (M AND NOT R): award 3 if it is fully correct. If a gate is missing or an extra gate makes the logic wrong, max 2.
6(a) J277 2.4.1	Max 3: the technician is not correct, with a counter-example: A = 0, B = 1 (and C = 1) A AND B = 0 (because A is 0) NOT B = 0, so (NOT B) AND C = 0 (even though C is 1) ...so P = 0 OR 0 = 0	**3**	"Not correct" with no reason scores 0. For full marks the answer must give the inputs A = 0, B = 1, C = 1 (the only case where C = 1 gives P = 0) or describe them ("when B is 1 and A is 0"). Credit working shown as values written on the circuit. Do not accept "the technician is correct": this scores 0.

Example answer for 5(b)



Total for this mark scheme: 21 marks