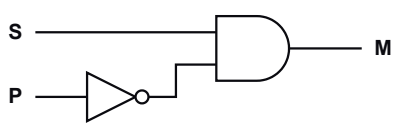
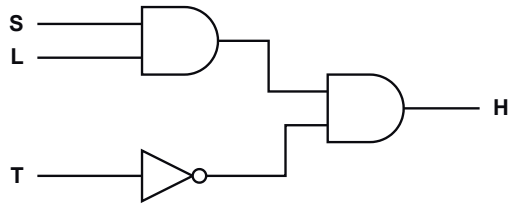
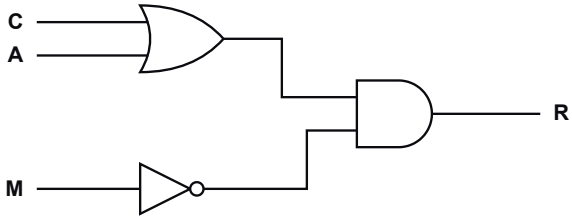
MODULE Q BOOLEAN LOGIC · Q7

From problem statement to logic circuit: mark scheme

19 marks · OCR J277 spec 2.4.1: simple logic diagrams using AND, OR and NOT; truth tables; combining Boolean operators; applying logical operators in truth tables to solve problems; create, complete or edit logic diagrams and truth tables for given scenarios; more than one gate in a logic diagram

How to use. 1 mark per bullet up to the maximum shown. **/** separates alternative answers. Words in (brackets) are not needed for the mark. Other valid notation is accepted, as in the J277 specification: T/F for 1/0, ∧ for AND, ∨ for OR, ¬ or a bar for NOT. Diagrams are marked on the gate shapes, not on labels: a NOT gate must have its circle; an AND or OR gate with a circle is a different gate and scores 0 for that gate. A box with the gate name written inside scores 0.

QUESTION	ANSWER	MARKS	GUIDANCE
1 J277 2.4.1	Paper shredder: **AND** Doorbell: **OR** Freezer warning light: **NOT** Lift alarm: **OR**	**4**	1 mark per correct row. A row with more than one tick scores 0.
2(a) J277 2.4.1	Either: S = 1, P = 0 … … the diagram gives 0 and it should give 1 Or: S = 1, P = 1 … … the diagram gives 1 and it should give 0	**2**	1 mark for a set of input values that gives a wrong output; 1 mark for both outputs correct for that set. The second mark depends on the first. Accept the answer in words (e.g. "switch on and someone in the pool: the cover closes but it should not"). S = 0 (either value of P) scores 0: the diagram is correct for those inputs.
2(b) J277 2.4.1	NOT gate with input P AND gate with inputs S and the output of the NOT gate, giving output M Example answer:  	**2**	1 mark per bullet. The NOT gate must have its circle. A NOT gate on S instead of P scores 0. Max 1 if any extra gate is drawn.
3(a) J277 2.4.1	H: 1 = the heater is on; 0 = the heater is off	**1**	Both meanings are needed for the mark.

QUESTION	ANSWER	MARKS	GUIDANCE
3(b) J277 2.4.1	S AND L … AND NOT T Example answer: `H = (S AND L) AND NOT T`	**2**	1 mark per bullet. Accept the inputs in any order and with or without brackets, e.g. `S AND L AND NOT T`, `(NOT T) AND (S AND L)`, S ∧ L ∧ ¬T. Do not award the second mark for `NOT (S AND L AND T)`, `OR NOT` T or `AND T`.
3(c) J277 2.4.1	AND gate with inputs S and L NOT gate with input T AND gate with the outputs of the first AND gate and the NOT gate as inputs, giving output H Example answer: 	**3**	1 mark per bullet. Accept the gates in another arrangement that gives the same result, e.g. L AND NOT T first, then AND with S. Accept one 3-input AND gate with inputs S, L and the NOT gate's output for bullets 1 and 3. Max 2 if any extra gate is drawn.
4(a) J277 2.4.1	An AND gate (in the box) Completed diagram: 	**1**	The shape must be an AND gate with no circle on the output. Do not accept an OR gate, or AND with a circle (NAND). Ignore labels.
4(b) J277 2.4.1	1 mark for each pair of rows (rows 1–2, 3–4, 5–6, 7–8): C A M **R** 0 0 0 **0** 0 0 1 **0** 0 1 0 **1** 0 1 1 **0** 1 0 0 **1** 1 0 1 **0** 1 1 0 **1** 1 1 1 **0**	**4**	Both outputs in a pair must be correct for the mark. Accept T/F for 1/0. R is 1 only when (C or A is 1) and M is 0. Follow through from an incorrect gate in 4(a) is **not** allowed: the table must match the scenario.

Total: 19 marks