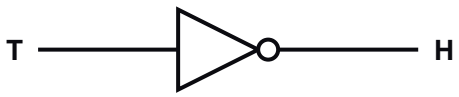
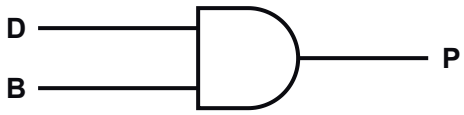
MODULE Q BOOLEAN LOGIC · Q1

Logic gates: AND, OR and NOT: mark scheme

20 marks · OCR J277 spec 2.4.1 (simple logic diagrams using AND, OR and NOT; truth tables; recognition of each gate symbol)

How to use. 1 mark per bullet up to the Max shown. **/** separates alternative answers. Words in (brackets) are not needed for the mark. Other valid notation is accepted, as the J277 specification allows: T/F or True/False for 1/0, and symbols such as ∨ for OR, ∧ for AND, ¬ or a bar over the letter for NOT. Logic diagrams: gate **shapes** are marked; a box with the gate's name written in it is not a gate symbol (0 for that gate). A NOT gate must have its small circle; an AND or OR gate must not have one.

QUESTION	ANSWER	MARKS	GUIDANCE
1(a) J277 2.4.1	X: OR Y: NOT Z: AND	**3**	1 mark per correct gate. Accept disjunction / negation / conjunction. Accept "inverter" for Y.
1(b) J277 2.4.1	OR	**1**	Accept ∨. Do not accept AND or NOT.
2(a) J277 2.4.1	Only one input: NOT Output 1 when either or both inputs are 1: OR Output 0 if any input is 0: AND	**3**	1 mark per correct row. More than one tick in a row: 0 for that row.
3(a) J277 2.4.1	`A AND B`, A = 1, B = 0: **0** `A OR B`, A = 0, B = 1: **1** `NOT A`, A = 1: **0** `A OR B`, A = 0, B = 0: **0**	**4**	1 mark per correct row. Accept F/T or False/True for 0/1.
4(a) J277 2.4.1	A NOT gate symbol: triangle with a small circle at the output ... ... with T as its only input and H as its output (no other gates) 	**2**	Triangle without the circle (a buffer) = 0 for the first mark. The circle may be drawn at the input side of the triangle. Second mark: the connection mark is lost if any extra gate is drawn. Labels are already printed; do not penalise if the candidate also writes them.
4(b) J277 2.4.1	H = NOT T	**1**	Accept ¬T, T with a bar over it, NOT(T). Do not accept "T NOT" or "H = T".
5(a) J277 2.4.1	AND	**1**	Accept conjunction / ∧.

QUESTION	ANSWER	MARKS	GUIDANCE
5(b) J277 2.4.1	An AND gate symbol (flat back, D shape, no circle) ... ... with D and B as its two inputs and P as its output (no other gates)  	**2**	An OR or NOT shape, or an AND with a circle at the output, = 0 for the first mark. The second mark can still be given for a single two-input gate wired D and B in, P out, only if the first mark is given. Max 1 if extra gates are drawn.
5(c) J277 2.4.1	1 mark each to max 3: OR outputs 1 when either input is 1 / when at least one input is 1 / it does not need both inputs to be 1 A correct example where the inputs differ: D = 1, B = 0 (door closed, no bike) / D = 0, B = 1 (door open, bike plugged in) ... ... OR would give P = 1 so the charger would be on when it should be off / AND gives 0 for this combination The charger must only be on when both conditions are true / both inputs are 1, and only AND does this	**3**	The third bullet needs a correct example (the "..."). Accept the example described in words (e.g. "the door is open but a bike is plugged in"). An example with D = 1, B = 1 or D = 0, B = 0 earns no example mark (OR and AND give the same output). Do not credit "OR is wrong" or "it is less safe" with no reason. Credit any other valid explanation.

Total: 20 marks