Set 1 Mark Scheme – Logic Gates & Control Systems

<table>
<tr><th>Q</th><th>Expanded Answer Guidance</th><th>Marks</th></tr>
<tr><td>1a</td><td>AND gate (accept: logical AND symbol, correct identification from diagram)</td><td>1</td></tr>
<tr><td>1b</td><td>Base ideas:
• Output is HIGH only when both inputs are HIGH
• Output is 1 only if all inputs are 1

Additional acceptable points:
• If any input is 0 → output is 0
• Behaves like multiplication in binary logic
• Used where multiple conditions must be met simultaneously
• Both switches must be closed (analogy accepted)</td><td>2</td></tr>
<tr><td>1c</td><td><table><tr><th>A</th><th>B</th><th>Q</th></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>1</td></tr><tr><td>1</td><td>0</td><td>1</td></tr><tr><td>1</td><td>1</td><td>1</td></tr></table></td><td>2</td></tr>
<tr><td>2a</td><td>• Inputs correctly labelled (A, B, etc.)
• Output correctly labelled (Q/Y)
• Direction of signal understood</td><td>1</td></tr>
<tr><td>2b</td><td><table><tr><th>A</th><th>B</th><th>Q_1</th><th>Q_2</th></tr><tr><td>0</td><td>0</td><td>0</td><td>1</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>0</td></tr></table></td><td>2</td></tr>
<tr><td>2c</td><td>NAND gate (accept: NOT-AND, inverted AND)</td><td>1</td></tr>
<tr><td>2d</td><td>• AND gate combines A and B
• NOT gate applied to C
• OR gate combines both signals

Accept:
• Correct logic even if drawing style differs
• Minor drawing errors if logic is clear</td><td>3</td></tr>
</table>

3	Band 1 (1–2): • Simple example (e.g. alarm OR switch) • Limited explanation Band 2 (3–4): • Clear example (e.g. safety system, machine start) • Explains OR = any input activates output Band 3 (5): • Strong engineering context (e.g. emergency stop, sensors) • Justifies why OR is appropriate • Links logic to real behaviour	5
4a	Open loop: • No feedback • Output not adjusted • Fixed operation Closed loop: • Uses feedback • Output is monitored • System self-corrects Accept: • Examples embedded in explanation	4
4b	Band 1 (1–2): • Basic example (e.g. toaster, timer) Band 2 (3–4): • Explains process and output • Mentions no feedback Band 3 (5–6): • Full system description (input → process → output) • Clearly states no feedback • Realistic engineering example	6
5a	Closed-loop system (due to feedback from heat sensor)	1

5b	Input: • Desired temperature / user setting Process: • Arduino processing signal Output: • Heating element / heat energy Feedback: • Heat sensor / temperature reading Controller: • Arduino / microcontroller	2
5c	Open-loop advantages: • Simple • Cheap • Fast response • Easy to maintain Closed-loop advantages: • Accurate • Self-correcting • Handles disturbances • Stable output Accept: • Comparative answers • Real-world examples	5