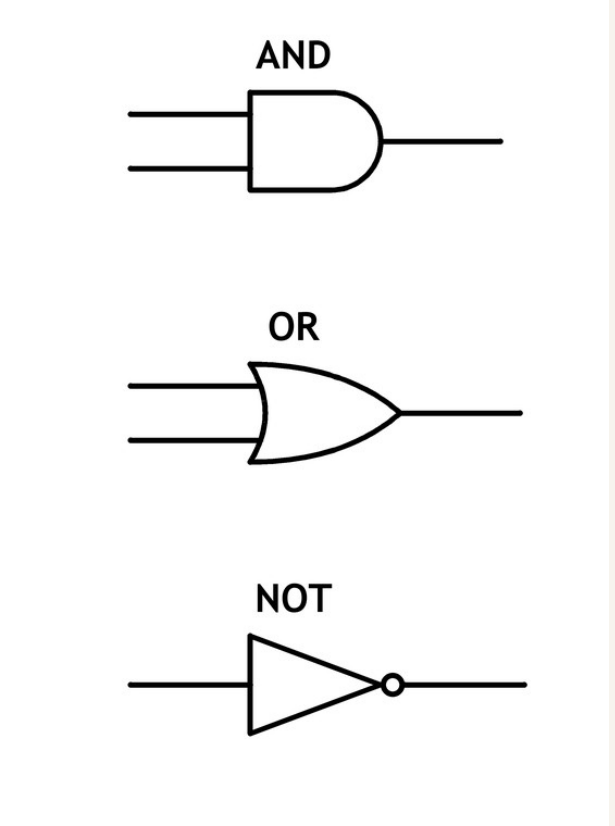
AND, OR and NOT Gates

This press only moves when both hands are on the buttons.



National 5 Engineering Science

Daily Review



1	**State** the voltage of **logic 1** (5 V system).	Near 5 V
2	Push button: **analogue** or **digital**?	Digital
3	**State** what **digitalRead** returns.	HIGH or LOW
4	**State** what an **NPN transistor** does here.	Acts as a switch
5	**State** the **unit** of **resistance**.	Ohm (Ω)

PART 1

The Three Gates

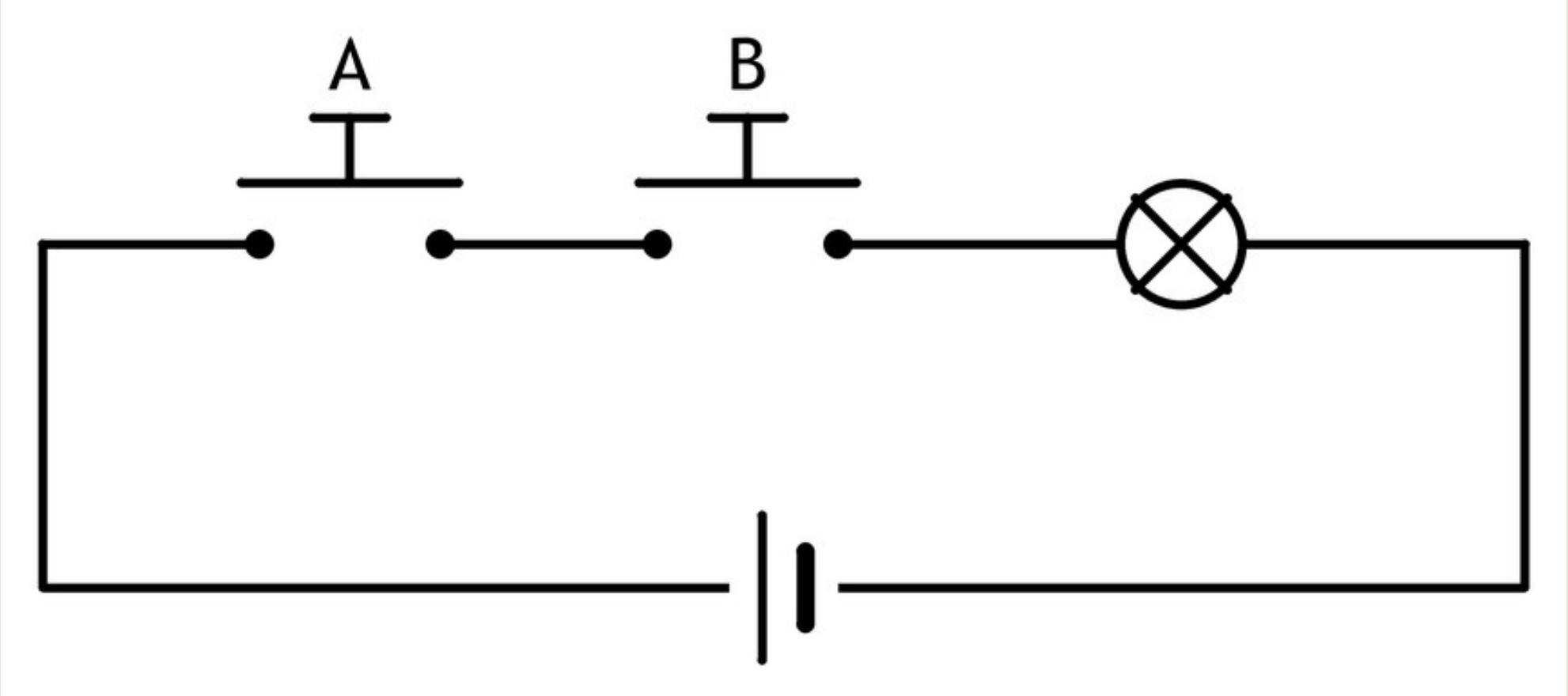
We are learning the symbol, the rule and the truth table for AND, OR and NOT gates.

By the end of this part…



1. I can **draw** the **AND**, **OR** and **NOT** symbols
2. I can **describe** what each gate **does**
3. I can **complete** the **truth table** for each gate

Two buttons, one motor. How do we make it need both?

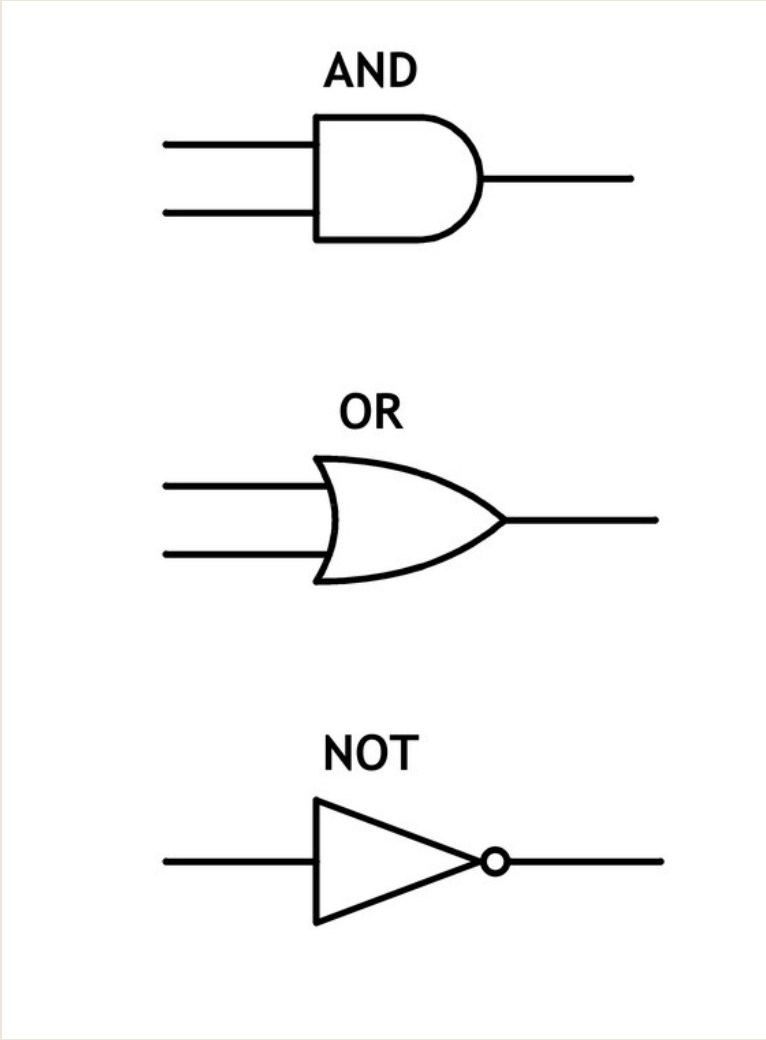


What a Logic Gate Is

Digital **inputs** in: **1** or **0**.

One digital **output**, **Z**.

N5 gates: **AND**, **OR**, **NOT**.



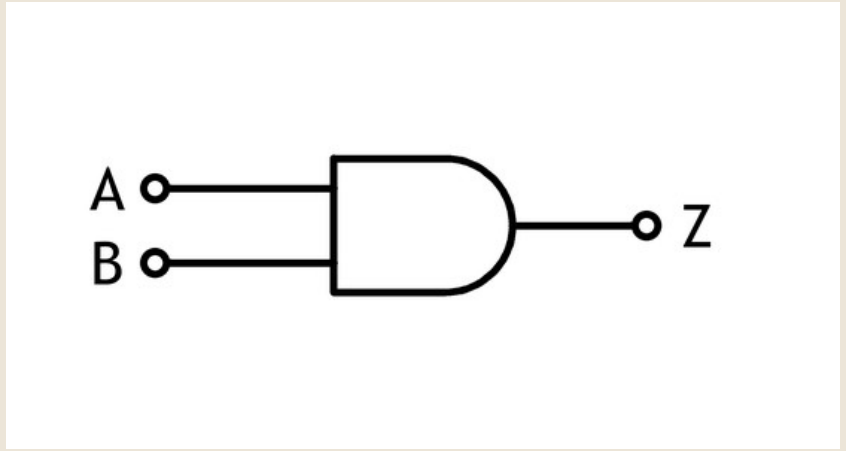
AND Gate

Z = **1** only when **all** inputs are **1**.

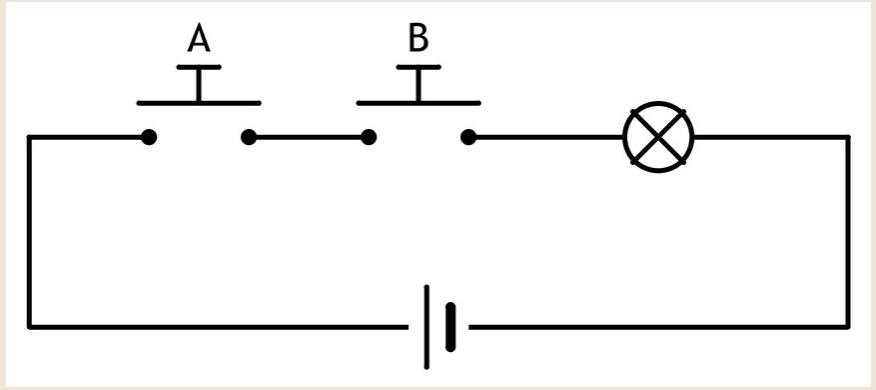
Like two switches in **series**.

Use: the **two-hand press**.

Your booklet calls the output **Q**.



A	B	Z
0	0	0
0	1	0
1	0	0
1	1	1

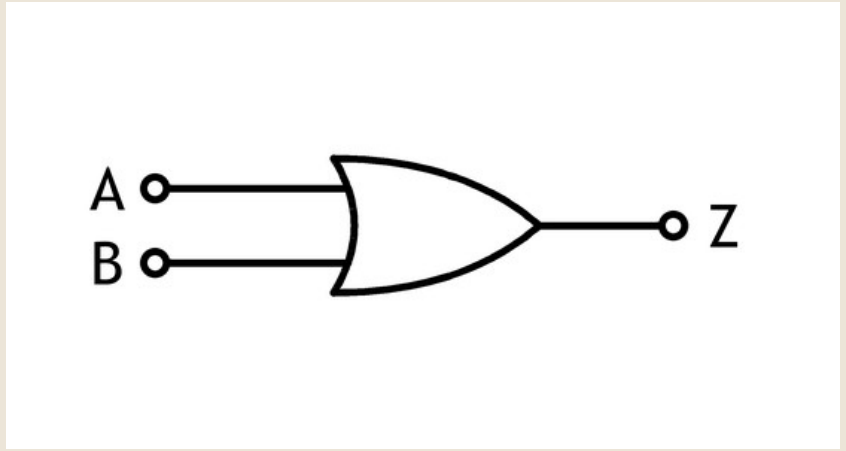


OR Gate

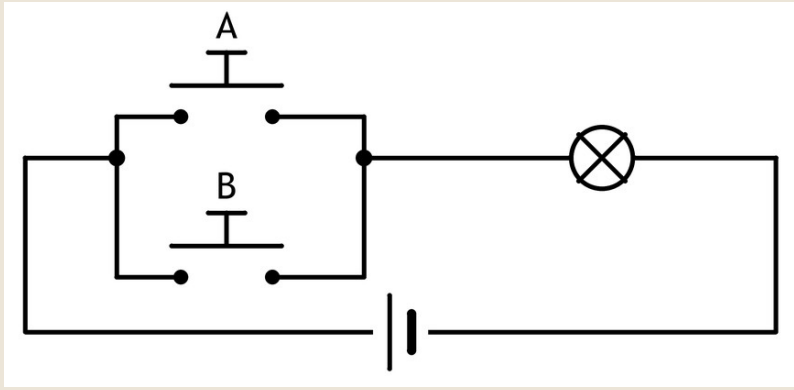
Z = **1** when **any** input is **1**.

Like two switches in **parallel**.

Use: an alarm on **any** door.



A	B	Z
0	0	0
0	1	1
1	0	1
1	1	1



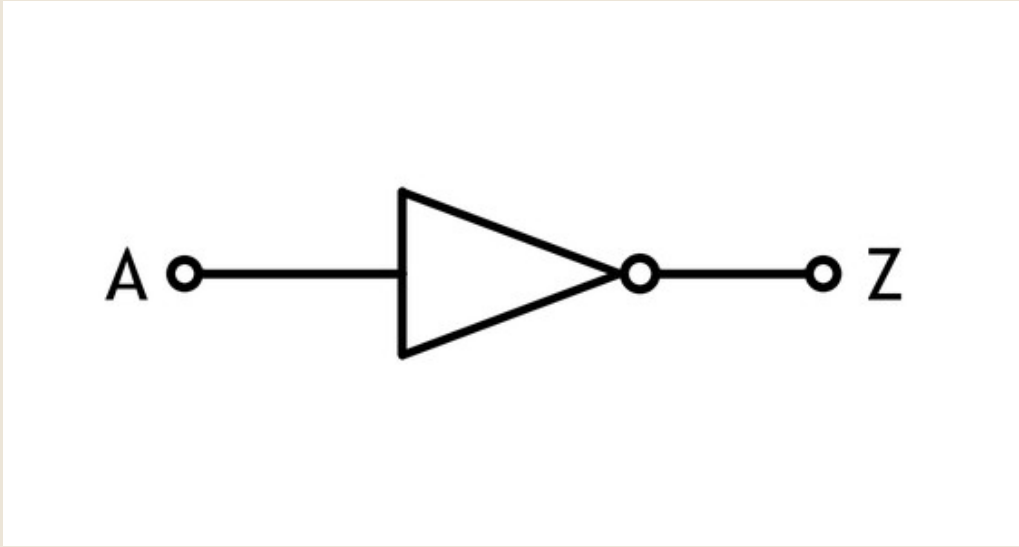
NOT Gate

One input.

Output is the **opposite**.

Also called an **inverter**.

Use: fridge light on when the door is **not** closed.



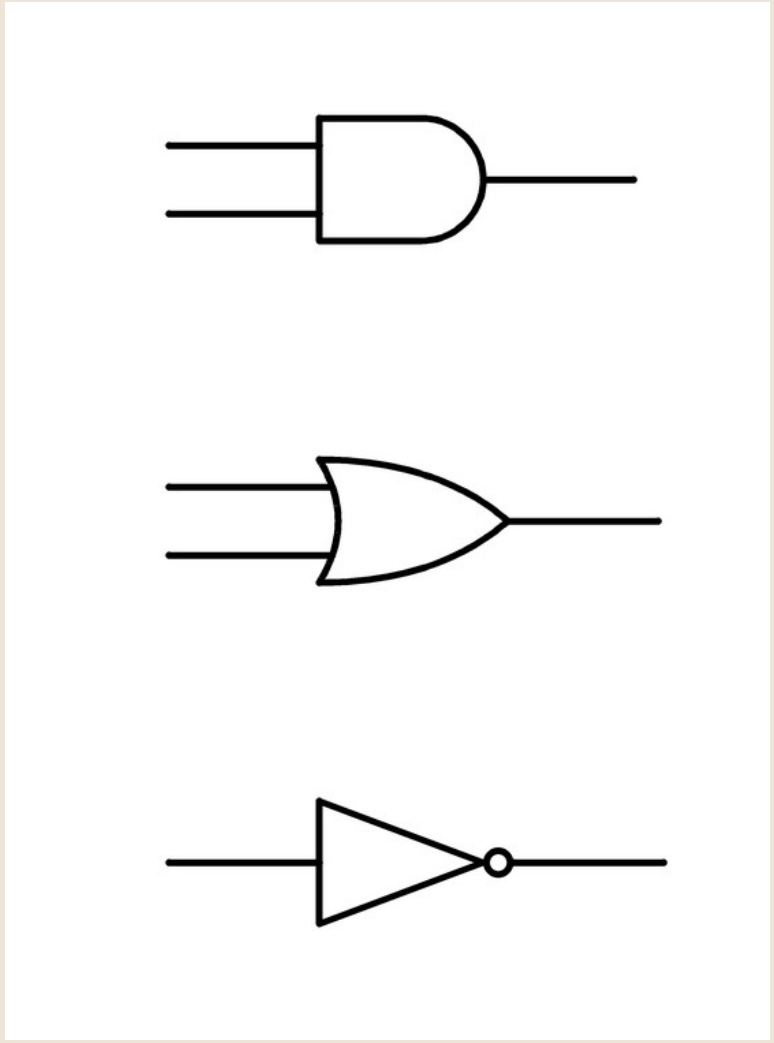
A	Z
0	1
1	0

Drawing the Symbols

1 Draw the **shape**.

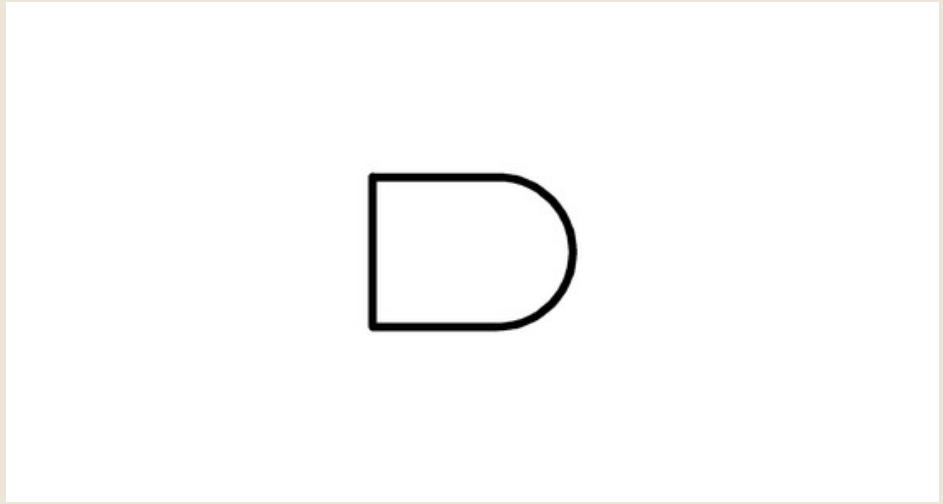
2 Add the **input** lines.

3 Add the **output** line.



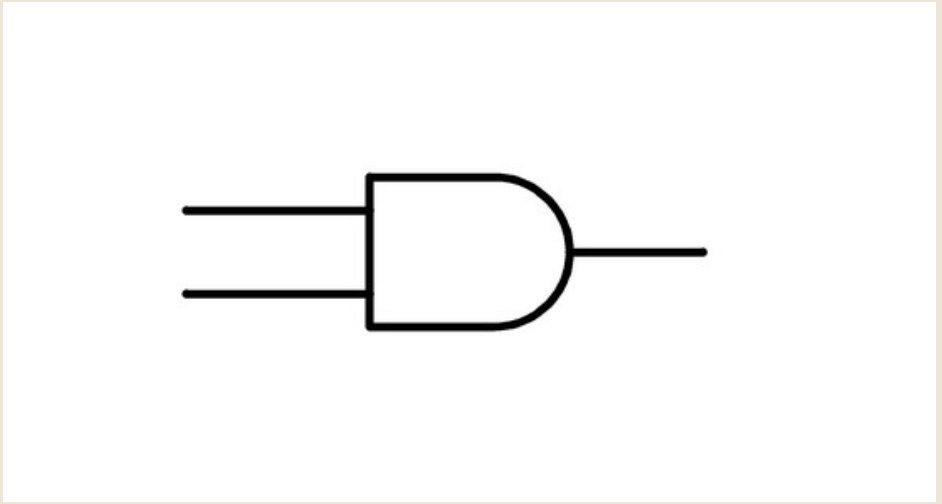
Watch Out: Draw the Lines

THE MISTAKE



A shape on its own: **0 marks.**

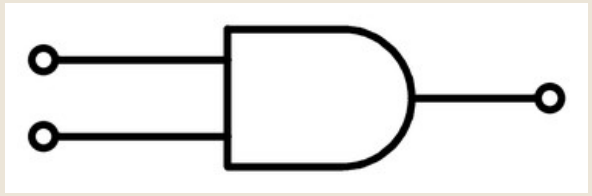
THE CORRECT ANSWER



Inputs and **output** drawn: **1 mark.**

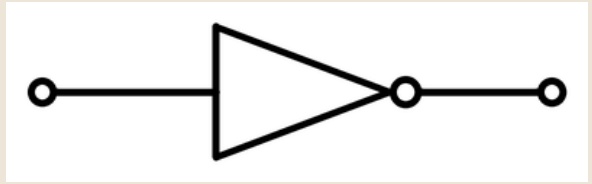
Show Me: Name the Gate

1



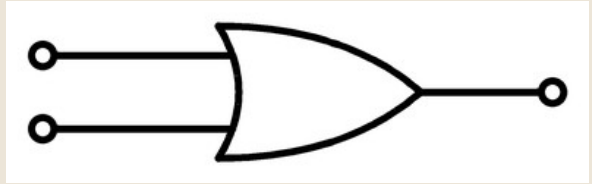
AND

2



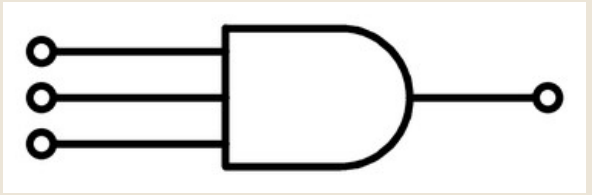
NOT

3



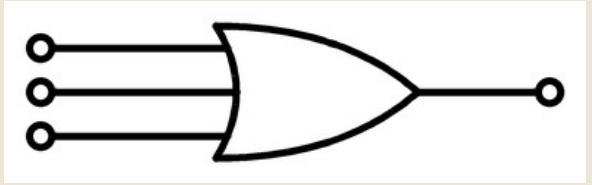
OR

4



AND

5



OR

Show Me: Which Gate?



1. Lift moves when the door is **closed** and a floor is **chosen**.
2. Car light on when **either** door is open.
3. Heater on when the room is **not** warm.
4. Conveyor runs when **start** and the **guard** switch are on.
5. Bell rings from **either** of two buttons.

AND

OR

NOT

AND

OR

Show Me: Draw It

1. **Draw** the symbol for an **OR** gate.

2. **State** Z for an **AND** gate when A = 1, B = 0.

3. **State** Z for an **OR** gate when A = 0, B = 1.

Shield, 2 inputs, 1 output

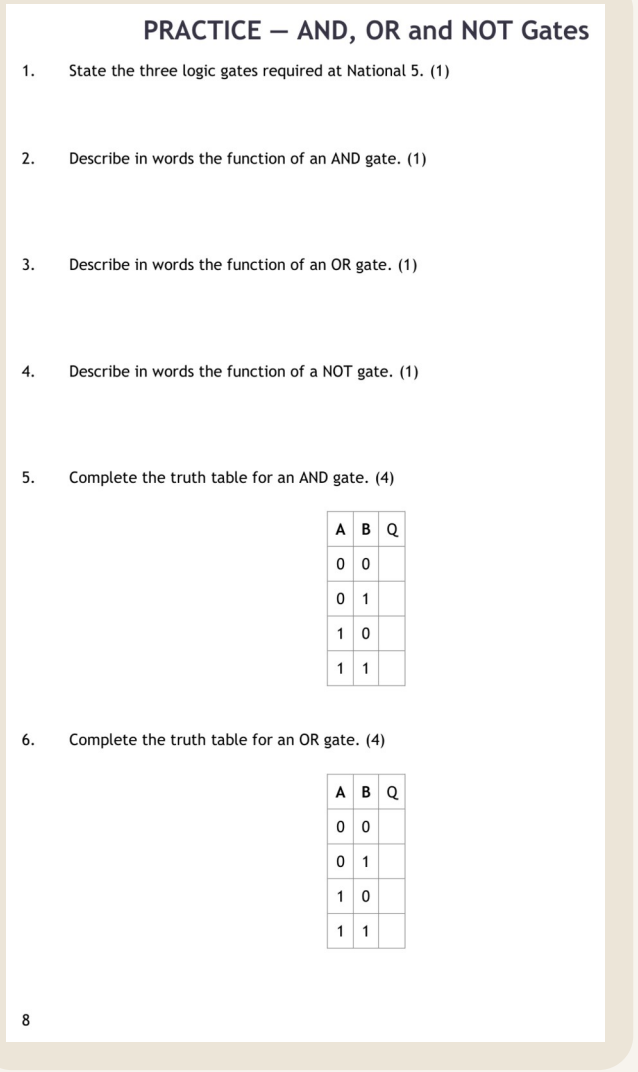
0

1

Review Questions (Booklet pages 8–9)

Review Questions

Answer Questions **1** to **10** on your own.
Questions **7** to **10** are on **page 9**.



PRACTICE — AND, OR and NOT Gates

1. State the three logic gates required at National 5. (1)

2. Describe in words the function of an AND gate. (1)

3. Describe in words the function of an OR gate. (1)

4. Describe in words the function of a NOT gate. (1)

5. Complete the truth table for an AND gate. (4)

A	B	Q
0	0	
0	1	
1	0	
1	1	

6. Complete the truth table for an OR gate. (4)

A	B	Q
0	0	
0	1	
1	0	
1	1	

8

Answers: Review Questions (1 of 2)



Q	Answer
1	**AND**, **OR**, **NOT**
2	Output is **1** only when **all** inputs are **1**
3	Output is **1** when **any** input is **1**
4	Output is the **opposite** of the input
5	Q column: **0**, **0**, **0**, **1**
6	Q column: **0**, **1**, **1**, **1**

Answers: Review Questions (2 of 2)



Q	Answer
7	**AND** gate
8	**OR** gate
9	Logic **0**
10	It **inverts**: the output is the **opposite** of the input

2024 Section 1 Question 1

1. Digital electronic signals can be controlled using logic gates.

   (a) State the logic gate with a **single** input that will change a high input to a low output. **1**

   (b) Draw the symbol for an AND gate. **1**

Marking: 2024 Section 1 Question 1

Question	Expected response	Max mark	Additional guidance
1 (a)	NOT (gate)/Inverter	1	Do not accept symbol.
(b)	AND symbol, with its input and output lines	1	Inputs and output must be shown. Accept more than two inputs.

Checkpoint

1. **Explain** why the two-hand press uses an **AND** gate.

   Needs **both**, **so** no hand is under it

2. **State** another name for **NOT**.

   Inverter

3. **OR** gate: **state** when Z = **0**.

   Only A = 0, B = 0

Look back — by the end of this part…



1. I can **draw** the **AND**, **OR** and **NOT** symbols
2. I can **describe** what each gate **does**
3. I can **complete** the **truth table** for each gate

Daily Review



1	**AND**: A = 1, B = 1. **State** Z.	1
2	**OR**: A = 0, B = 1. **State** Z.	1
3	**NOT**: A = 1. **State** Z.	0
4	**AND**: A = 0, B = 1. **State** Z.	0
5	**OR**: A = 0, B = 0. **State** Z.	0

PART 2

Testing the Gates

We are learning to test a logic gate and record its truth table.

By the end of this part…



1. I can **build** a gate test with **labelled inputs**
2. I can **test every input combination** in order
3. I can **check my results** against the truth table

PRACTICAL

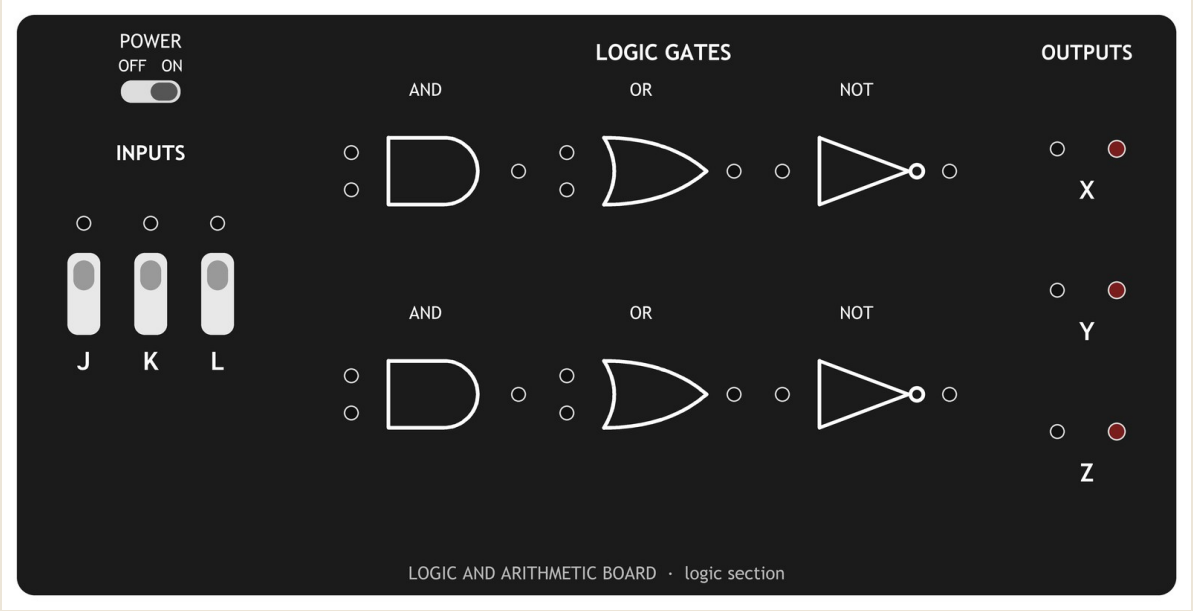
Practical Task 1

Test AND, OR and NOT on the logic kit or in Yenka.

What to Collect

Collect one set per pair.

1. **Logic and Arithmetic** board
2. **Flying leads** (3)
3. Your **booklet**, page **7**
4. Hold the board by its **edges**.



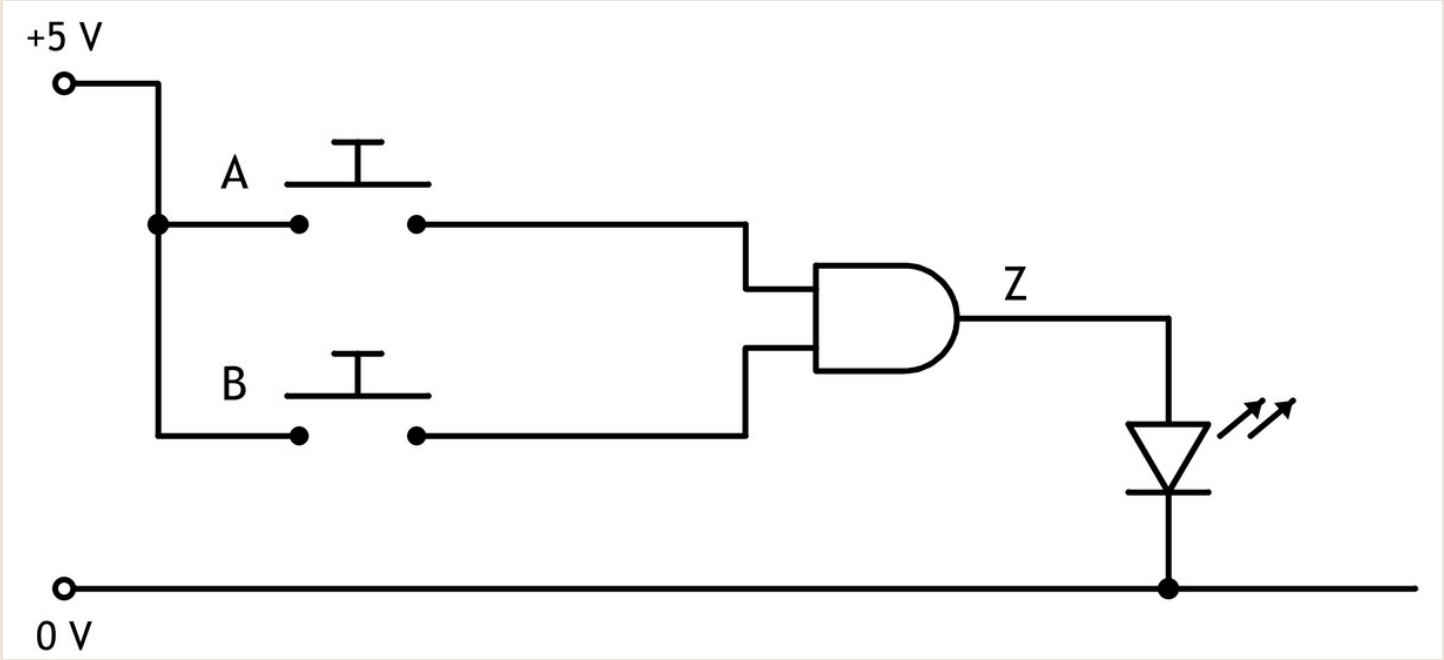
How to Test a Gate

A **switch** on **every** input.

Label them **A** and **B**.

Switch up = **1**. LED on = **1**.

Test **00, 01, 10, 11** in order.



Practical Task 1 (B4a-L2-p7)

Practical Task 1

Connect J (A) and **K** (B) to the **AND** gate.
Connect its output to LED **Z**.
Test 00, 01, 10, 11 and **record** Z.
Repeat for **OR**, then **NOT**.

SAFETY Never join two outputs.

PRACTICAL TASK 1 — AND, OR and NOT on the Logic Kit

Aim

To use the Computer Science Logic and Arithmetic Kit (or Yenka) to test the truth tables for AND, OR and NOT gates.

Equipment

- University of Southampton Computer Science Logic and Arithmetic Kit (or Yenka)
- Two input switches and one output LED
- AND, OR and NOT gate blocks

Method

- Connect input switches to the AND gate. Connect the output to an LED.
- Set each input combination (00, 01, 10, 11) and record the output.
- Repeat for OR.
- Repeat for NOT (one input only).

Results:

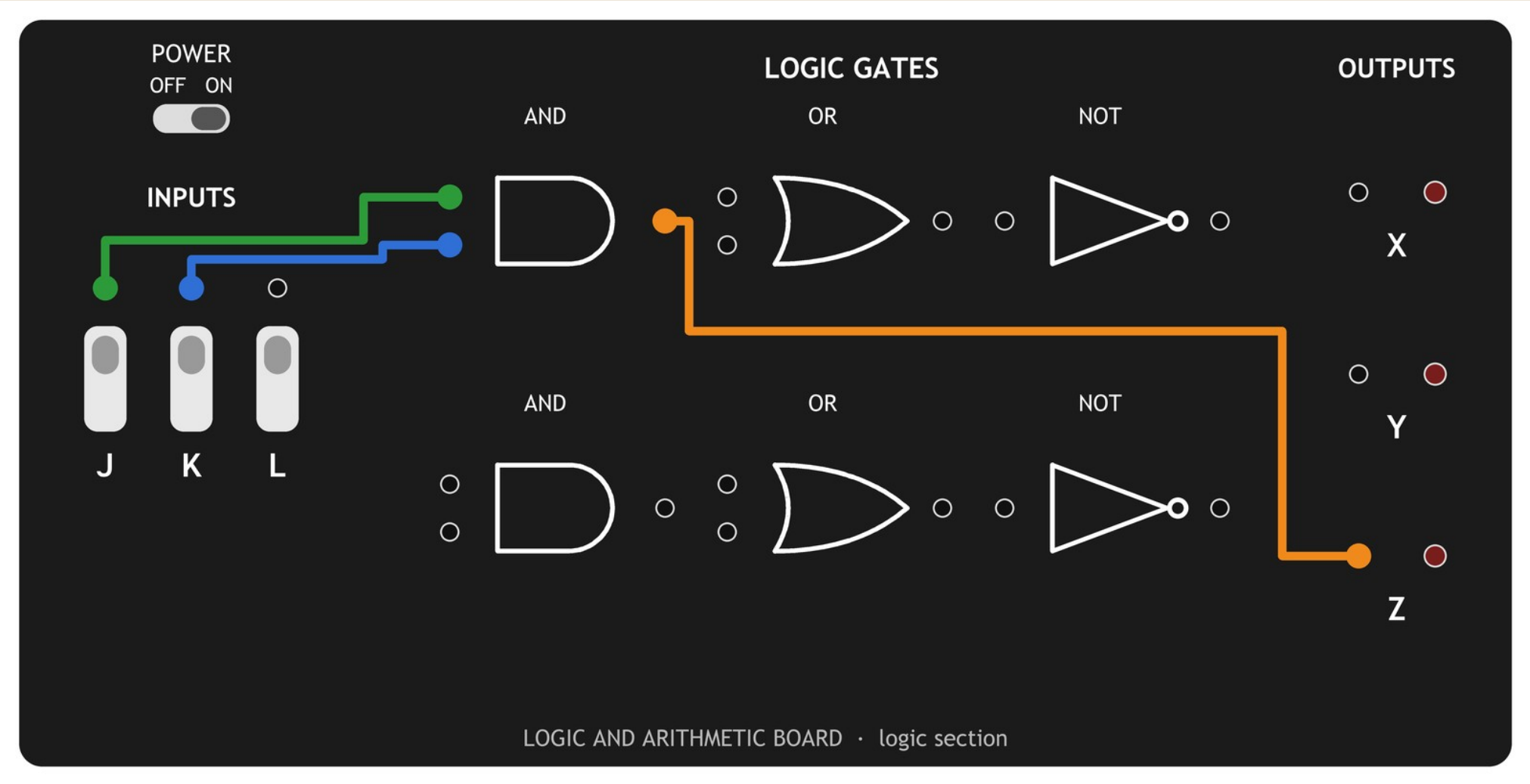
A	B	Q
0	0	
0	1	
1	0	
1	1	

A	B	Q
0	0	
0	1	
1	0	
1	1	

A	Q
0	
1	

7

Build It: Bench Card 1



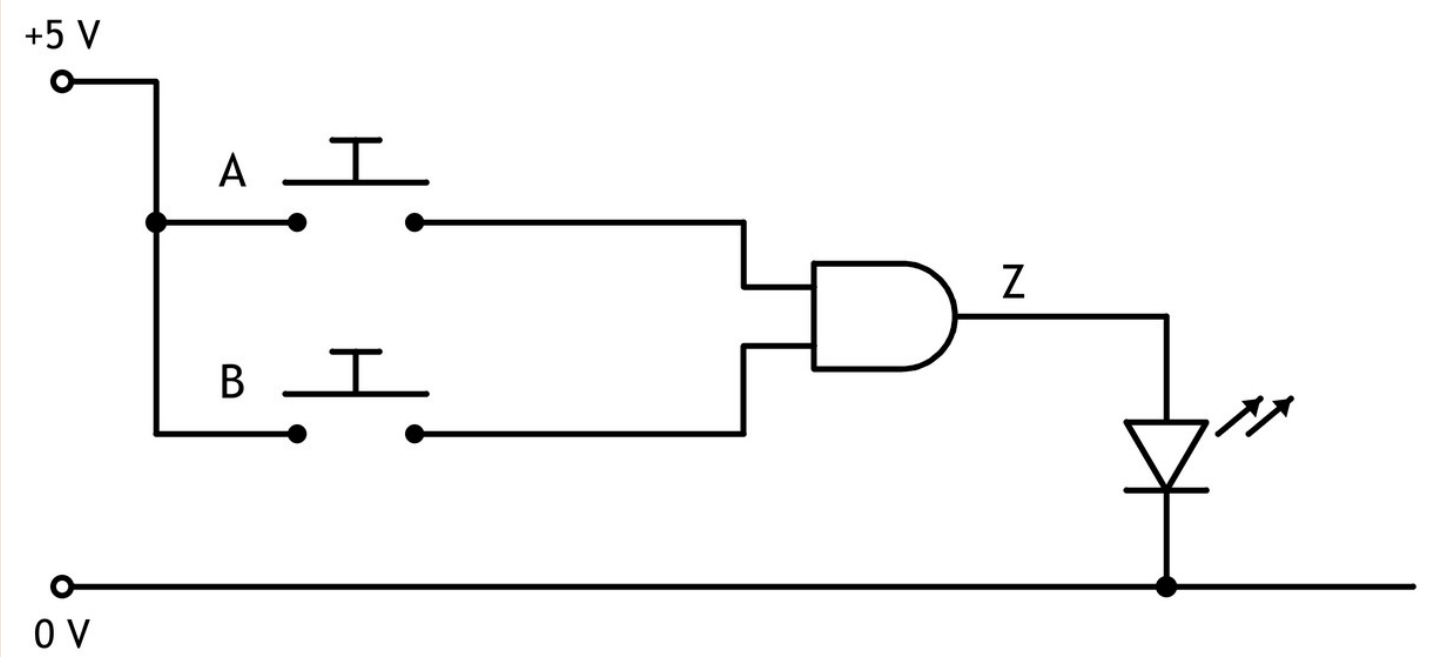
No Kit at Your Bench? Yenka

Same test in **Yenka**.

Two **switches**, labelled **A** and **B**.

Gate, then an **LED** to **0 V**.

Swap in **OR**, then **NOT**.



Answers: Practical Task 1



AND

A	B	Z
0	0	0
0	1	0
1	0	0
1	1	1

OR

A	B	Z
0	0	0
0	1	1
1	0	1
1	1	1

NOT

A	Z
0	1
1	0

Checkpoint



1. **Explain** why we test **00, 01, 10, 11** in order.

None missed, **so** table complete

2. **State** why each input needs a **label**.

To know which is A, which is B

3. A 2-input gate: **state** how many rows.

4

Look back — by the end of this part…



1. I can **build** a gate test with **labelled inputs**
2. I can **test every input combination** in order
3. I can **check my results** against the truth table

Extension



1. **State** how many rows a **3-input AND** needs.
2. **Write** the full **3-input OR** truth table.
3. **Name** the gate that lights a lamp when a switch is **off**.

Course Specification — 1 of 1

Digital electronic control systems

- AND, OR and NOT gates and combinations with up to three inputs, using truth tables, logic diagrams and Boolean expressions

Credits (1 of 2)

Drawings: Gate symbols, logic diagrams and circuits drawn by R Stewart; booklet pages from Booklet 4a, Logic and Digital Control.

Watch Out (marking instructions): © Qualifications Scotland (SQA). 2024 National 5 Engineering Science Section 1, Q1(b) marking instructions

2024 Section 1 Question 1: © Qualifications Scotland (SQA). 2024 National 5 Engineering Science Section 1, Q1

Marking: 2024 S1 Q1: © Qualifications Scotland (SQA). 2024 National 5 Engineering Science Section 1, Q1 marking instructions

Screenshots and page figures: Booklet 4a, Logic and Digital Control: page images, Berwickshire High School.

Logic board: Logic board drawn by R Stewart from the UKESF / University of Southampton Logic and Arithmetic kit teacher guide.

Bench card: Logic board drawn by R Stewart from the UKESF / University of Southampton Logic and Arithmetic kit teacher guide.

Credits (2 of 2)

Course specification: © Qualifications Scotland (SQA). N5 Engineering Science course specification v2.0, p.5

R Stewart - November 2026