Truth Tables for Combinations

A washing machine checks three things before it spins.

National 5 Engineering Science

Daily Review

1. **AND**: A = 1, B = 0. **State** Z.
2. **State** what the **bubble** on a NOT gate shows.
3. **State** the logic state of a **lamp** that is **on**.
4. **State** what **pinMode** sets.
5. **State** what happens to **R** of a **thermistor** when hot.

PART 1

Rows and Two Inputs

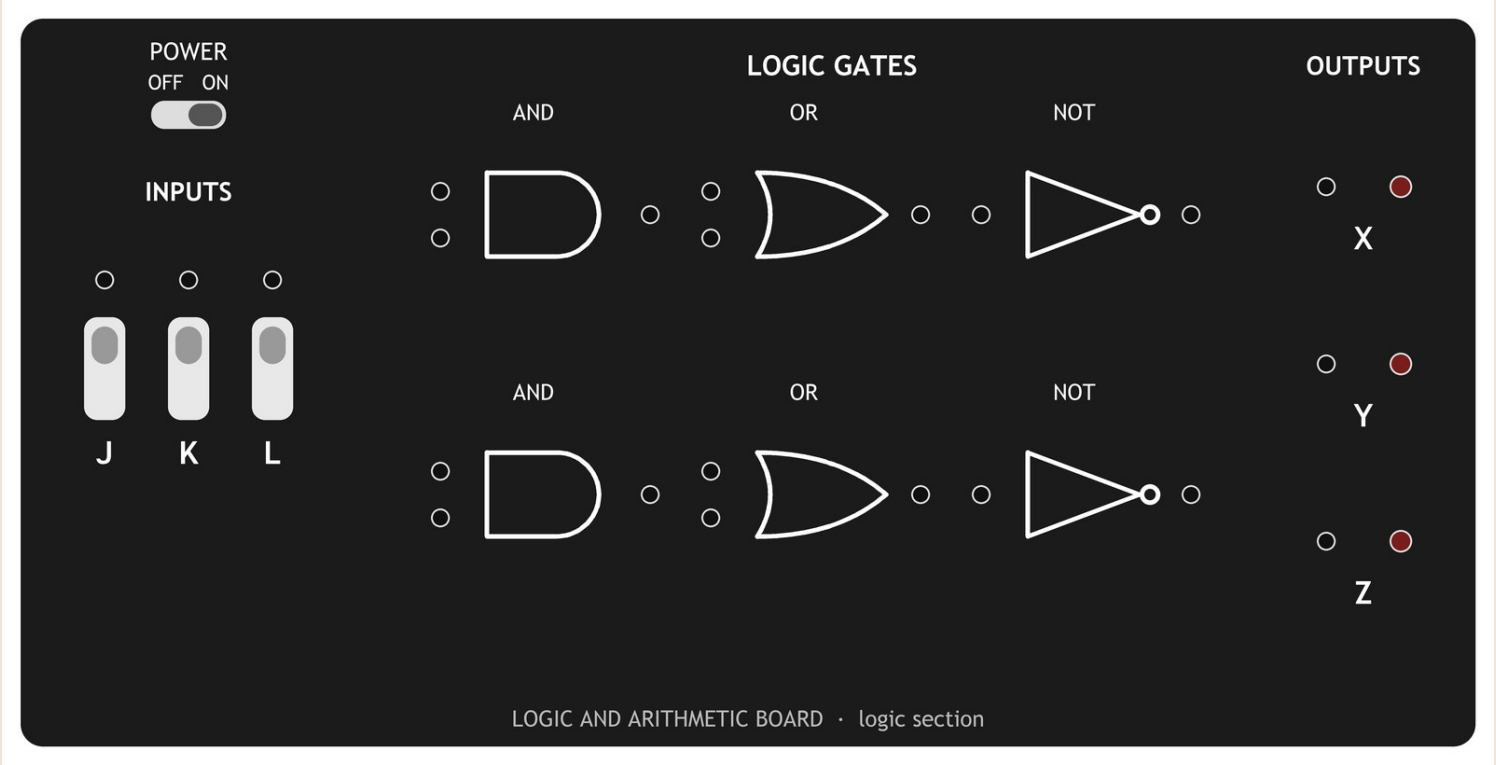
We are learning to count truth table rows and to work out two-input combinations one gate at a time.

By the end of this part…



1. I can **state** how many **rows** a truth table needs
2. I can **fill in** the **input columns** in order
3. I can **complete** a truth table **one gate at a time**

Three switches. How many different ways can they be set?



How Many Rows?

Rows = 2^n

n = number of **inputs**.

1 → **2**, 2 → **4**, 3 → **8**.

A
0
1

A	B
0	0
0	1
1	0
1	1

A	B	C
0	0	0
0	0	1
0	1	0
0	1	1
1	0	0
1	0	1
1	1	0
1	1	1

Filling the Input Columns

C column: **0 1 0 1…**

B column: **0 0 1 1…**

A column: **0 0 0 0 1 1 1 1.**

Counting in **binary**, so **no row** is missed.

A	B	C
0	0	0
0	0	1
0	1	0
0	1	1
1	0	0
1	0	1
1	1	0
1	1	1

Show Me: Rows



1. **State** how many rows for **1** input.
2. **State** how many rows for **3** inputs.
3. **State** the **4th** row for 3 inputs.
4. **State** the row after **1 0 1**.
5. **State** the **last** row for 2 inputs.

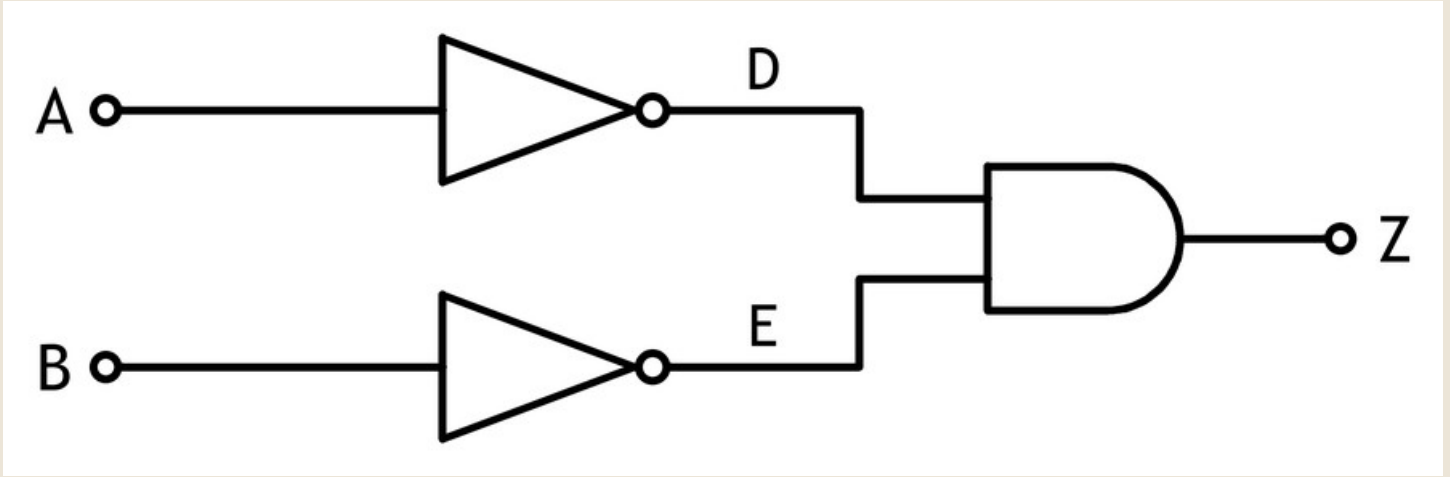
One Gate at a Time

Combinational: no memory.

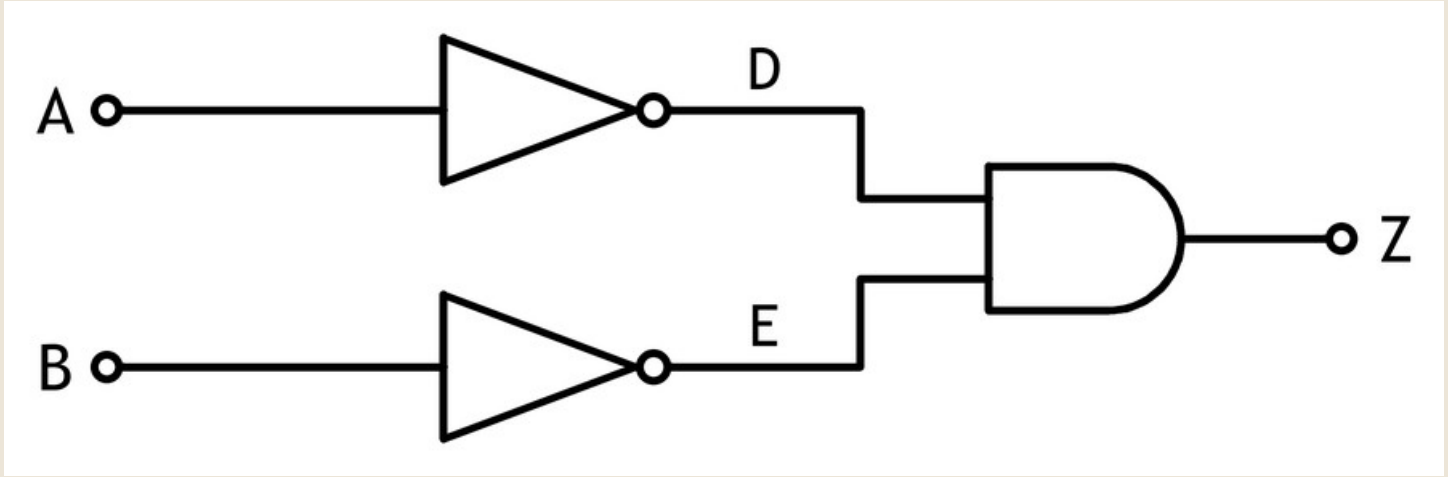
Label each gate's output: **D**, **E**.

One **column** each, **Z** last.

Your booklet calls it **X**.



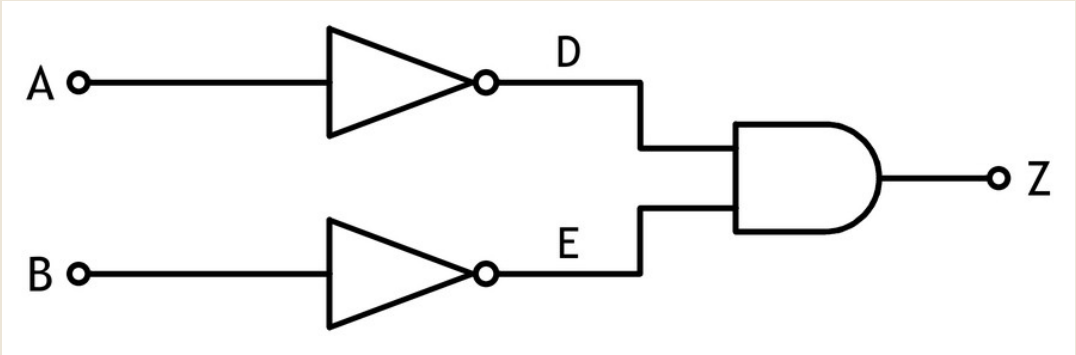
Worked Example 1



A	B	D	E	Z
0	0			
0	1			
1	0			
1	1			

Complete the truth table for the logic diagram shown above. **3**

Worked Example 1: Marking



Complete the truth table for the logic diagram shown above.

3

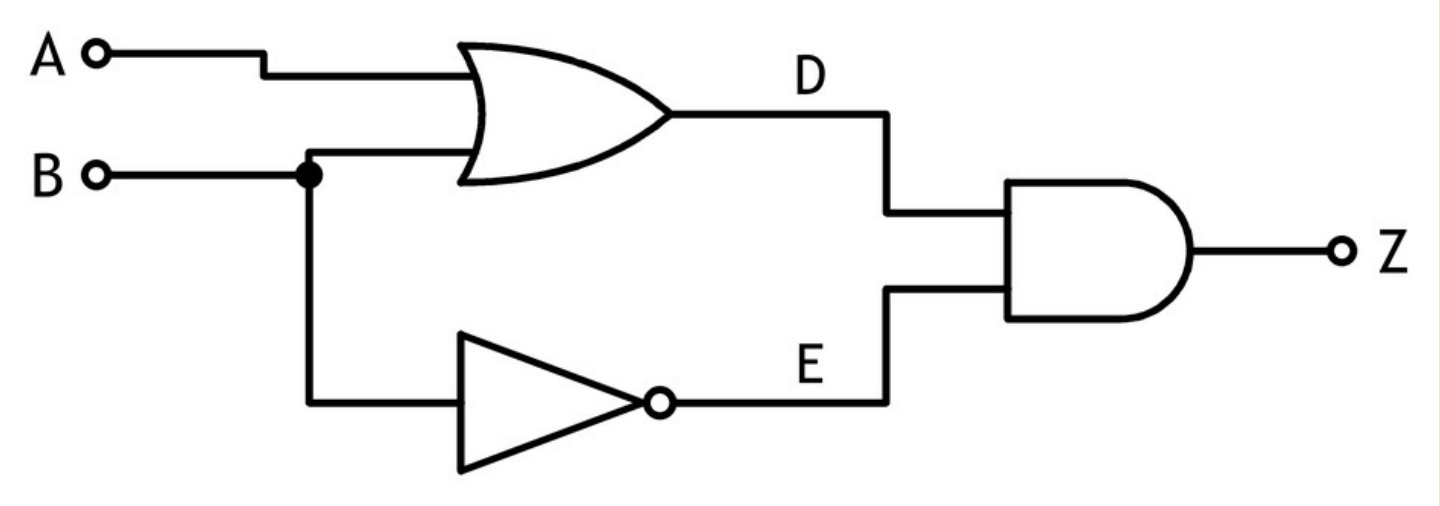
1 mark: column **D** = NOT A

1 mark: column **E** = NOT B

1 mark: column **Z** = D AND E

A	B	D	E	Z
0	0	1	1	1
0	1	1	0	0
1	0	0	1	0
1	1	0	0	0

Show Me: Your Turn



Complete the truth table for the logic diagram shown above. **3**

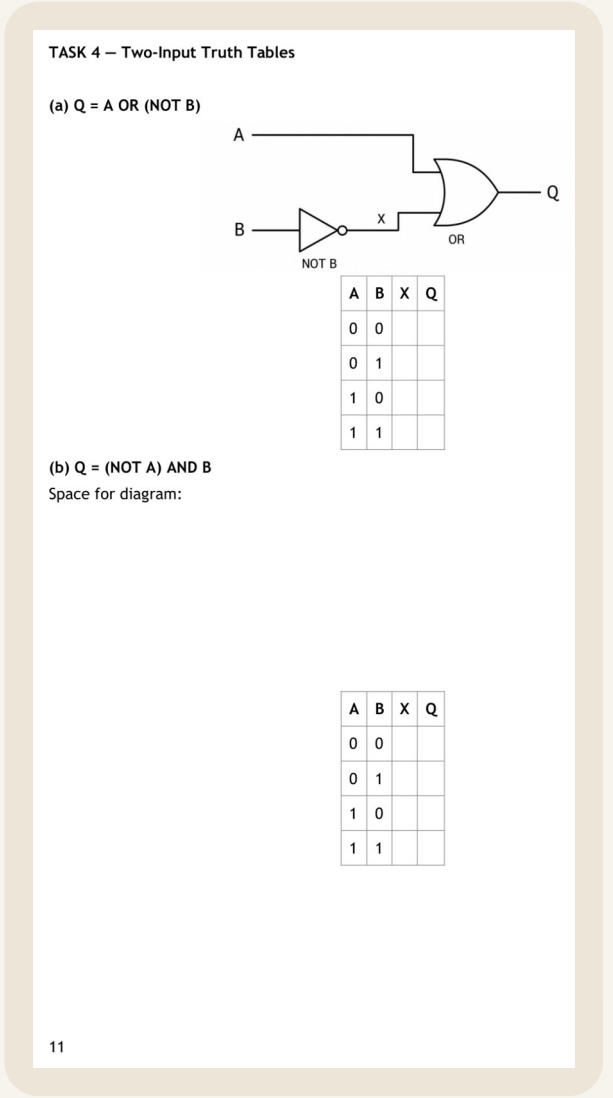
A	B	D	E	Z
0	0	0	1	0
0	1	1	0	0
1	0	1	1	1
1	1	1	0	0

Task 4 (B4a-L3-p11)

Task 4

(a) Complete the truth table.

(b) Draw the diagram, then **complete** the table.



TASK 4 — Two-Input Truth Tables

(a) Q = A OR (NOT B)

A	B	X	Q
0	0		
0	1		
1	0		
1	1		

(b) Q = (NOT A) AND B

Space for diagram:

A	B	X	Q
0	0		
0	1		
1	0		
1	1		

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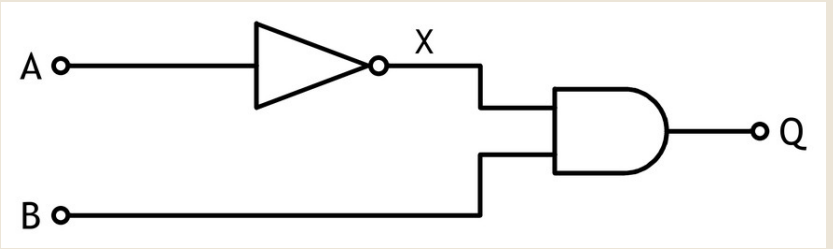
Answers: Task 4

(a)

A	B	X	Q
0	0	1	1
0	1	0	0
1	0	1	1
1	1	0	1

(b)

A	B	X	Q
0	0	1	0
0	1	1	1
1	0	0	0
1	1	0	0



Look back — by the end of this part…



1. I can **state** how many **rows** a truth table needs
2. I can **fill in** the **input columns** in order
3. I can **complete** a truth table **one gate at a time**

Daily Review



1. **State** how many rows for **3** inputs.
2. **State** the **3rd** row for 2 inputs.
3. **AND**: A = 1, B = 1. **State** Z.
4. **OR**: A = 0, B = 0. **State** Z.
5. **NOT**: A = 0. **State** Z.

PART 2

Three Inputs

We are learning to complete a three-input truth table the way the exam marks it.

By the end of this part…



1. I can **complete** a **three-input** truth table
2. I can **use** the **D** and **E** columns
3. I can **check** each column **scores** a mark

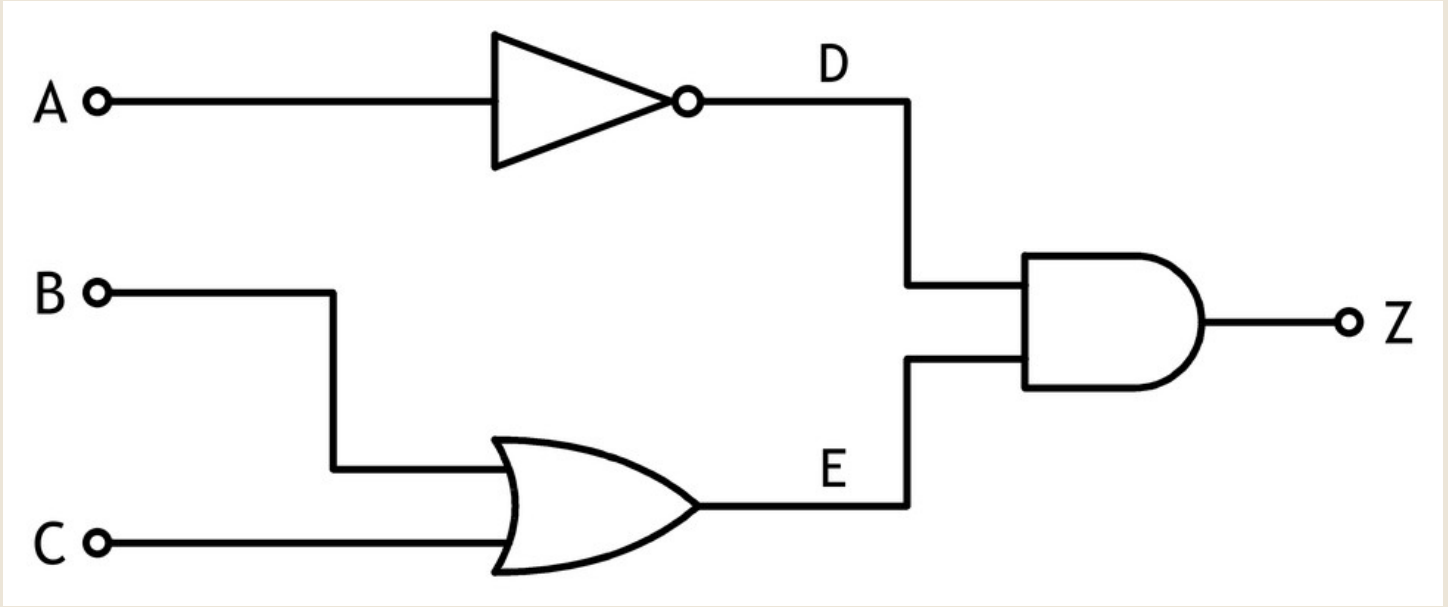
Three Inputs

8 rows.

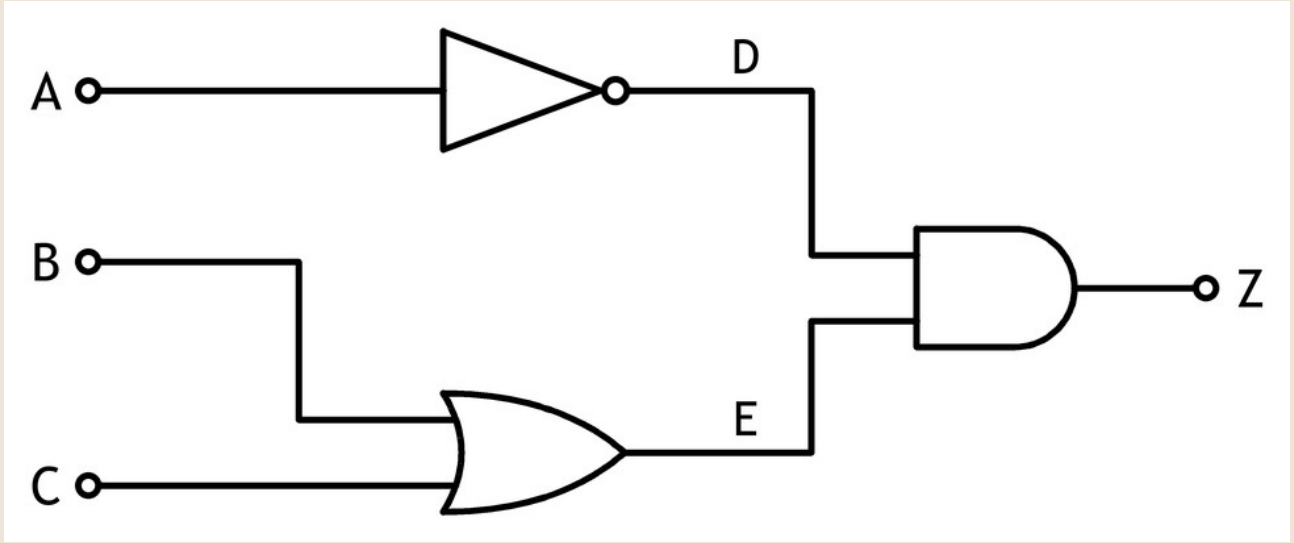
Inputs **A**, **B**, **C**.

Work out **D**, then **E**.

Z last, from D and E.



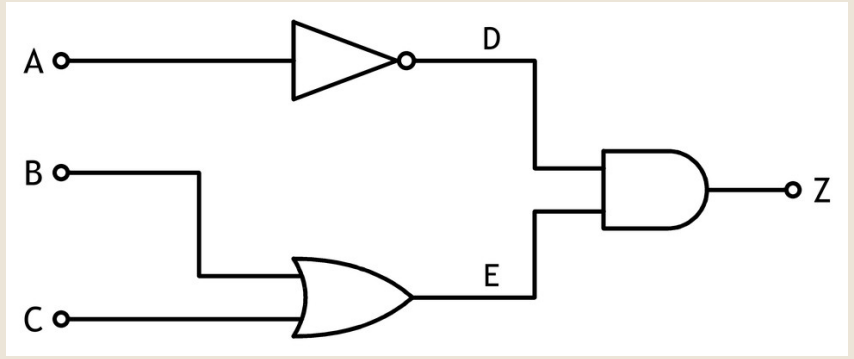
Worked Example 2



Complete the truth table for the logic diagram shown above. **3**

A	B	C	D	E	Z
0	0	0			
0	0	1			
0	1	0			
0	1	1			
1	0	0			
1	0	1			
1	1	0			
1	1	1			

Worked Example 2: Marking



Complete the truth table for the logic diagram shown above. **3**

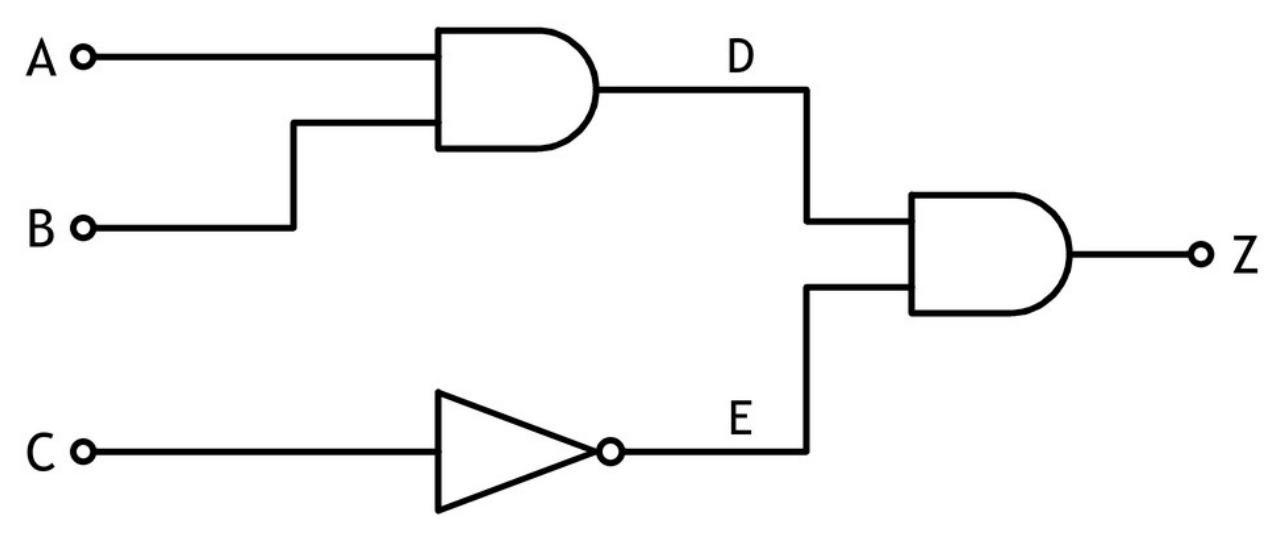
1 mark: **D** = NOT A

1 mark: **E** = B OR C

1 mark: **Z** = D AND E

A	B	C	D	E	Z
0	0	0	1	0	0
0	0	1	1	1	1
0	1	0	1	1	1
0	1	1	1	1	1
1	0	0	0	0	0
1	0	1	0	1	0
1	1	0	0	1	0
1	1	1	0	1	0

Show Me: Your Turn



Complete the truth table for the logic diagram shown above. **3**

A	B	C	D	E	Z
0	0	0	0	1	0
0	0	1	0	0	0
0	1	0	0	1	0
0	1	1	0	0	0
1	0	0	0	1	0
1	0	1	0	0	0
1	1	0	1	1	1
1	1	1	1	0	0

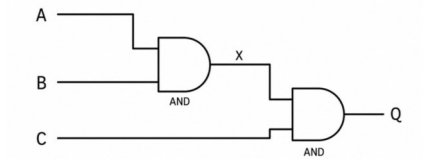
Task 5 (B4a-L3-p12)

Task 5

Complete the **X** column, then **Q**.

Three-Input Combinations

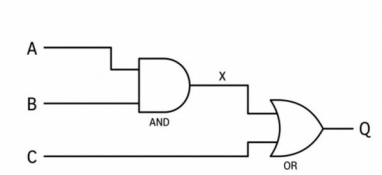
Worked Example — Q = A AND B AND C



A	B	C	X	Q
0	0	0	0	0
0	0	1	0	0
0	1	0	0	0
0	1	1	0	0
1	0	0	0	0
1	0	1	0	0
1	1	0	1	0
1	1	1	1	1

TASK 5 — Three-Input Truth Table

Complete the table for Q = (A AND B) OR C.



A	B	C	X	Q
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

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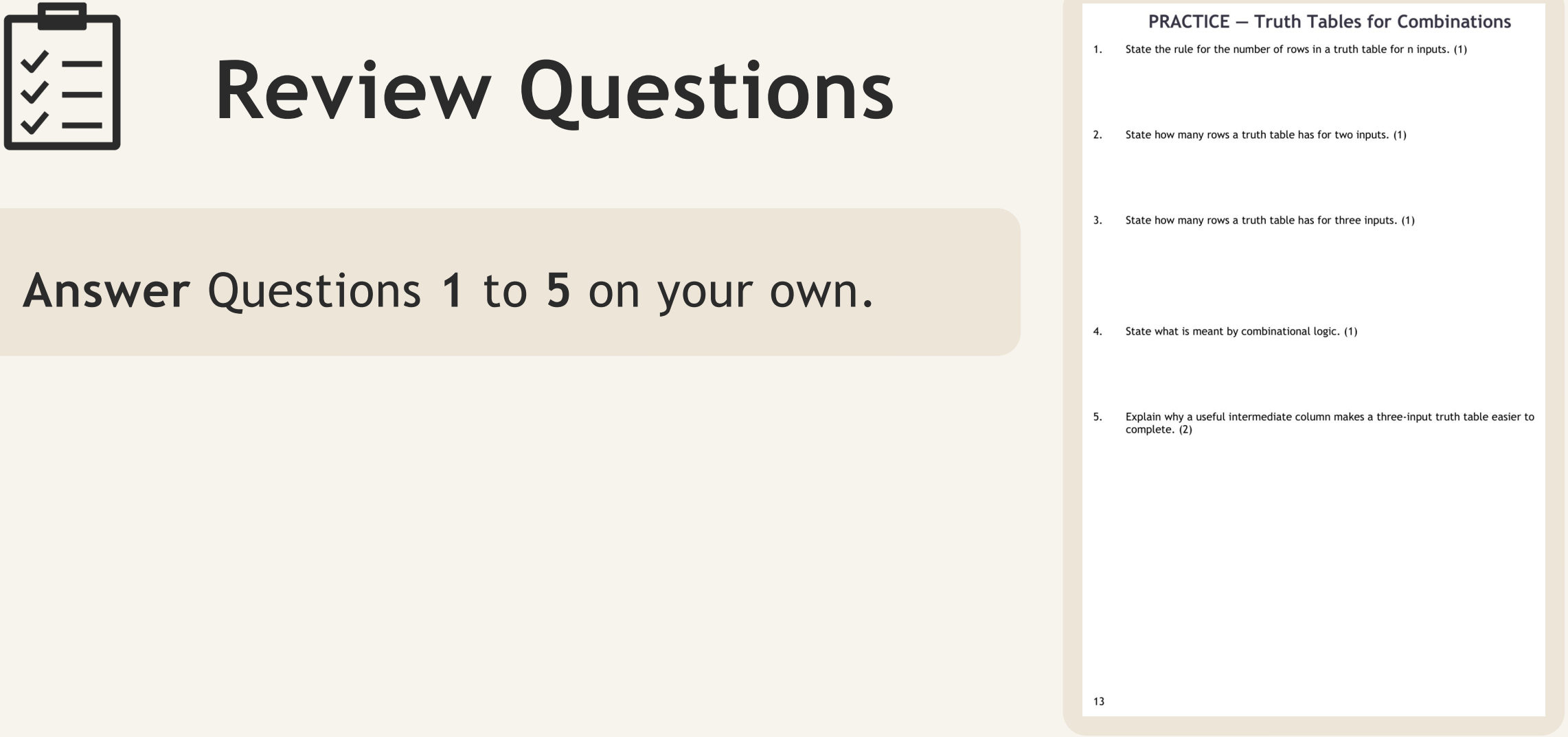
Answers: Task 5

A	B	C	X	Q
0	0	0	0	0
0	0	1	0	1
0	1	0	0	0
0	1	1	0	1
1	0	0	0	0
1	0	1	0	1
1	1	0	1	1
1	1	1	1	1

Review Questions (Booklet page 13)

Review Questions

Answer Questions **1** to **5** on your own.



PRACTICE — Truth Tables for Combinations

1. State the rule for the number of rows in a truth table for n inputs. (1)

2. State how many rows a truth table has for two inputs. (1)

3. State how many rows a truth table has for three inputs. (1)

4. State what is meant by combinational logic. (1)

5. Explain why a useful intermediate column makes a three-input truth table easier to complete. (2)

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Answers: Review Questions

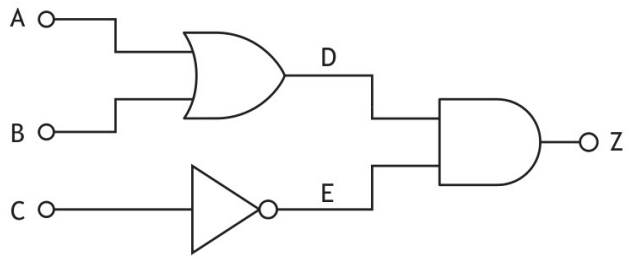


Q	Mark 1	Mark 2
1	Rows = 2^n	—
2	**4**	—
3	**8**	—
4	Depends on **inputs now** only	—
5	One gate **at a time**	**so** mistakes are easy to spot

2025 Section 2 Question 11 (c)

11. (continued)

Part of a logic diagram used in the control circuit of the ring light is shown below.



(c) Complete the truth table for the logic diagram shown above.

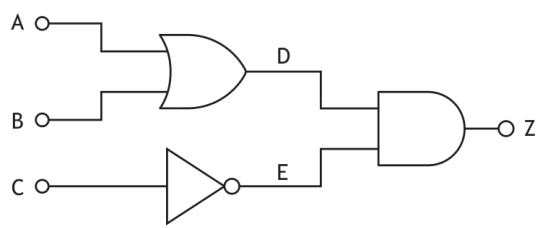
A	B	C	D	E	Z
0	0	0			
0	0	1			
0	1	0			
0	1	1			
1	0	0			
1	0	1			
1	1	0			
1	1	1			

(c) is worth
3 marks.

D first, then **E**,
then **Z**.

Marking: 2025 Section 2 Question 11 (c)

Part of a logic diagram used in the control circuit of the ring light is shown below.



(c) Complete the truth table for the logic diagram shown above.

Complete the truth table for the logic diagram shown above. **3**

1 mark: column **D** = A OR B

1 mark: column **E** = NOT C

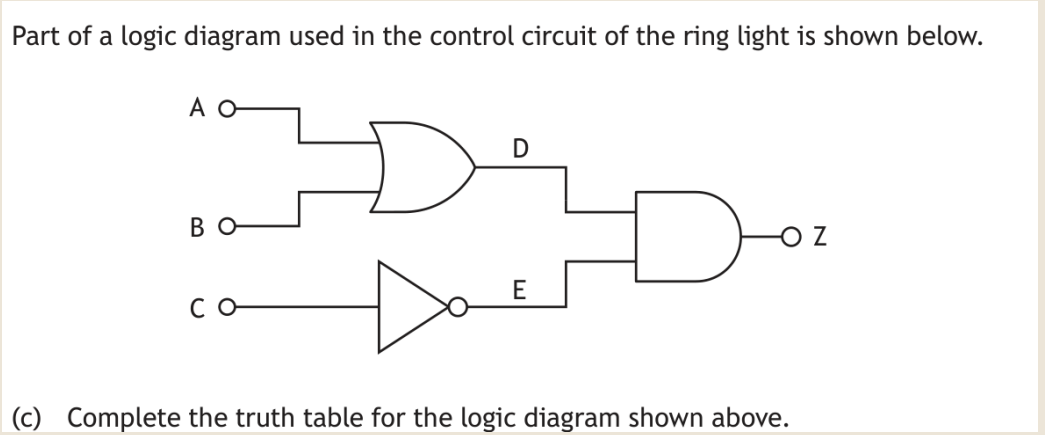
1 mark: column **Z** = D AND E

A	B	C	D	E	Z
0	0	0	0	1	0
0	0	1	0	0	0
0	1	0	1	1	1
0	1	1	1	0	0
1	0	0	1	1	1
1	0	1	1	0	0
1	1	0	1	1	1
1	1	1	1	0	0

Truth Tables in the Exam

Year	Questions	Marks
2026	S2 Q14(d)	3
2025	S2 Q11(c)	3
2024	S2 Q14(c)	3
2023	S2 Q12(f)	3

Scan the QR for every past paper by topic.



2025 Q11(c)

Checkpoint



1. **Explain** why we label **D** and **E**.

2. **State** the rows for **3** inputs.

3. D is wrong. **State** if Z can still score.

Look back — by the end of this part…



1. I can **complete** a **three-input** truth table
2. I can **use** the **D** and **E** columns
3. I can **check** each column **scores** a mark

Extension



1. D = NOT A, E = NOT C, Z = D OR E. **Complete** the table.

2. For interest: **state** the rows for **4** inputs.

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

Title: Photo: Fanti Salms, CC BY-SA 3.0, via Wikimedia Commons

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

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R Stewart - November 2026