

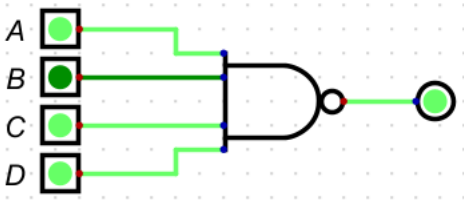
Part 1: Logic Gates and Truth Tables

1. Create Truth Tables (10 Points): For the following circuits, draw the truth table:

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

2. Gate Identification (5 Points): Identify the output for a 4-input NAND gate where the inputs are: A = 1, B = 0, C = 1, D = 1

The output is 1.



Part 2: Boolean Algebra Simplification (25 Points)

1. Expression Simplification (15 Points): Simplify the following Boolean expressions using Boolean algebra laws:

- $(A + A \cdot B)$
- $(A \cdot (B + C) + B \cdot C)$

Apply distributive law:

The simplified expression is: $A \cdot B + A \cdot C + B \cdot C$

- Verification with Truth Tables (10 Points): Create a truth table for the simplified expression in part 1(b) and compare it with the original

Truth Table for original expression:

A	B	C	$B + C$	$A \cdot (B + C)$	$B \cdot C$	Output
0	0	0	0	0	0	0
0	0	1	0	0	0	0
0	1	1	0	0	0	0
0	1	1	0	0	1	1
1	0	0	0	0	0	0
1	0	1	1	1	0	1
1	1	1	1	1	0	1
1	1	1	1	1	1	1

Truth Table for simplified expression:

A	B	C	$A \cdot B$	$A \cdot C$	$B \cdot C$	Output
0	0	0	0	0	0	0
0	0	1	0	0	0	0
0	1	0	0	0	0	0
0	1	1	0	0	1	1
1	0	0	0	0	0	0
1	0	1	0	1	0	1
1	1	0	1	0	0	1
1	1	1	1	1	1	1

Part 3: Karnaugh Maps and Minimization (25 Points)

- Karnaugh Map Construction (15 points):

	00	01	11	10
00	0	1	1	0
01	0	0	0	0
11	0	0	1	0
10	0	0	0	0

- Derive Simplified Expression (10 Points):
 $A'B'C'D + A'B'CD' + ABCD$

Part 4: Combinational Logic Applications (35 Points)

Deriving expressions for P0, P1, P2, and P3.

1. $P_0 = A_0 * B_0$
2. $P_1 = (A_1 * B_0) \oplus (A_0 * B_1)$
3. $P_2 = (A_1 * B_1) \oplus ((A_1 * B_0) * (A_0 * B_1))$
4. $P_3 = A_1 * B_1$

Full Adder Table:

A	B	Cin	Sum	Cout
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

$$\text{Sum} = A \oplus B \oplus \text{Cin}$$

$$\text{Cout} = (A * B) + (\text{Cin} * (A \oplus B))$$