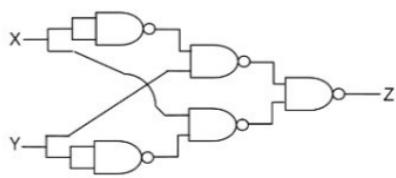


## GATE Question Paper 2010, IN Question Number 42

### Question 42 Analysis

Question:

The logic gate circuit shown in the figure realizes the function:



- (A) XOR    (B) XNOR    (C) Half Adder  
 (D) Full Adder

### Step-by-Step Analysis of the Circuit

Let the inputs be:

- **X** and **Y** (two binary inputs)

Circuit Analysis:

1. **Top-left gate (AND):** Inputs:  $X, Y$  Output:  $X \cdot Y$
2. **Bottom-left gate (NOR):** Inputs:  $X, Y$  Output:  $\overline{X + Y}$
3. **Middle gate (NAND):** Inputs:  $X, Y$  Output:  $\overline{X \cdot Y}$
4. **Final gate (OR):** Inputs: outputs from NOR and NAND Output:  $\overline{X + Y} + \overline{X \cdot Y}$

### Truth Table

X	Y	$X + Y$	$X \cdot Y$	$Z = \overline{X + Y} + \overline{X \cdot Y}$
0	0	1	1	1
0	1	0	1	1
1	0	0	1	1
1	1	0	0	0

This is the **truth table for XOR**.

### Final Answer

(A) XOR

### Brief Discussion

The circuit implements:

$$Z = \overline{X + Y} + \overline{X \cdot Y}$$

This expression matches the behavior of the XOR gate, which outputs 1 only when exactly one of the inputs is 1. Hence, the circuit realizes the XOR logic function.

### Abstract

This document presents the practical implementation of an XOR logic gate using both Arduino Uno and Raspberry Pi Pico W boards. It includes hardware requirements, pin mappings, connection diagrams, mobile upload steps, and testing results.

### Implementation using Arduino Uno

**Hardware Requirements:**

S.No	Component
1	Arduino Uno Board
2	Breadboard
3	Push Buttons (2)
4	LED
5	Resistors: $220\Omega$ , $10k\Omega$
6	Jumper Wires
7	USB Cable

Table 1: Arduino Hardware Components



#### Pin Connections:

Component	Arduino Pin
X (Button 1)	Digital 2
Y (Button 2)	Digital 3
LED Output	Digital 13
GND	GND
VCC	5V

Table 2: Pin Mapping for Arduino Uno

## Upload Steps

#### Upload Steps via Mobile:

1. Connect Arduino Uno to mobile via OTG.
2. Open ArduinoDroid app.
3. Select the correct board and paste the code.
4. Compile and Upload the code.
5. Assemble the circuit on a breadboard.
6. Verify LED output by pressing buttons.

## Observations

X	Y	LED Output
0	0	OFF
0	1	ON
1	0	ON
1	1	OFF

Table 3: XOR Truth Table on Arduino

## Conclusion

The circuit worked as expected for XOR operation using Arduino Uno.

## Implementation using Raspberry Pi Pico W

#### Hardware Requirements:

S.No	Component
1	Raspberry Pi Pico W
2	Breadboard
3	Push Buttons (2)
4	LED
5	Resistors: $220\Omega$ , $10k\Omega$
6	Jumper Wires
7	Micro USB Cable

Table 4: Pico W Hardware Components

#### Pin Connections:

Component	Pico W Pin
X (Button 1)	GP14
Y (Button 2)	GP15
LED Output	GP13
GND	GND
VCC	3.3V

Table 5: GPIO Pin Mapping for Pico W

## Upload Steps

#### Upload Steps via Mobile:

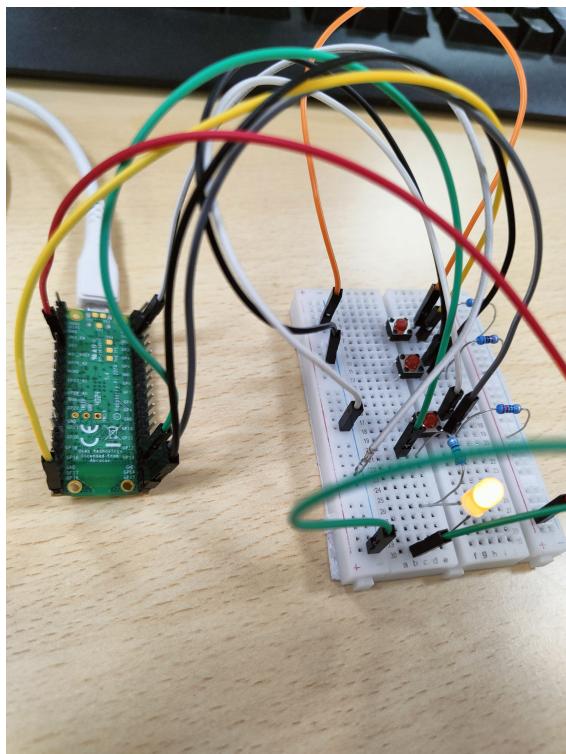
1. Connect Pico W to mobile using OTG while pressing BOOTSEL.

2. Copy MicroPython firmware (.uf2) to the board.
3. Open MicroREPL app.
4. Connect to Pico and paste the MicroPython code.
5. Connect the circuit.
6. Test functionality using buttons.

## Observations

X	Y	LED Output
0	0	OFF
0	1	ON
1	0	ON
1	1	OFF

Table 6: XOR Truth Table on Pico W



## Conclusion

The circuit worked as expected for XOR operation using Arduino Uno.

**GitHub Repository:** [https://github.com/ashok-kumar-reddy-17/Ashok\\_FWC](https://github.com/ashok-kumar-reddy-17/Ashok_FWC)