

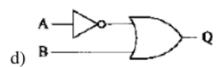
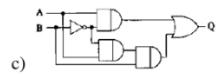
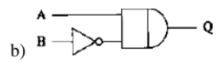
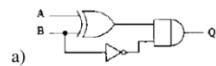
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GATE Question no. 41

Question

For any set of inputs A and B, the following circuits give the same output Q, except one.
Which one is it?

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Question Analysis

By simplifying the circuits using Boolean algebra:

Circuit (a):

$$Q = (A + B)\bar{B}$$

$$Q = A\bar{B} + B\bar{B}$$

Since $B\bar{B} = 0$

$$Q = A\bar{B}$$

Circuit (b):

$$Q = A\bar{B}$$

Circuit (c):

$$Q = A\bar{B}$$

Circuit (d):

$$Q = \bar{A} + B$$

Hence circuits (a), (b), and (c) produce identical outputs.

Circuit (d) produces a different output.

Correct Answer: (d)

Theoretical Background

Boolean algebra is the mathematical foundation of digital electronics.

Important laws used:

Complement Law: $A\bar{A} = 0$

Identity Law: $A + 0 = A$

Distributive Law: $A(B + C) = AB + AC$

The simplified function is:

$$Q = A\bar{B}$$

This means output is HIGH only when:

$$A = 1 \text{ and } B = 0$$

Truth Table

A	B	$A\bar{B}$	$\bar{A} + B$
0	0	0	1
0	1	0	1
1	0	1	0
1	1	0	1

The outputs clearly show that circuit (d) differs.

- Arduino UNO
- IC 7447 (BCD to 7-segment decoder)
- Common Anode 7-segment display
- Breadboard
- Jumper wires

Pin Connections

IC 7447 Connections

Pin 16 → 5V

Pin 8 → GND

Control pins 3, 4, 5 → 5V

Pins 1 and 2 → GND
Pin 7 → Arduino Pin 9

Arduino Inputs

Pin 10 → A
Pin 11 → B

7-Segment

Common Anode → 5V
Segment pins connected from 7447 outputs through resistors.

Logic Description

The Arduino provides inputs A and B.

The logical expression verified is:

$$Q = A\bar{B}$$

The output is displayed on a 7-segment display using IC 7447.

If $Q = 1$, display shows HIGH condition. If $Q = 0$, display shows LOW condition.

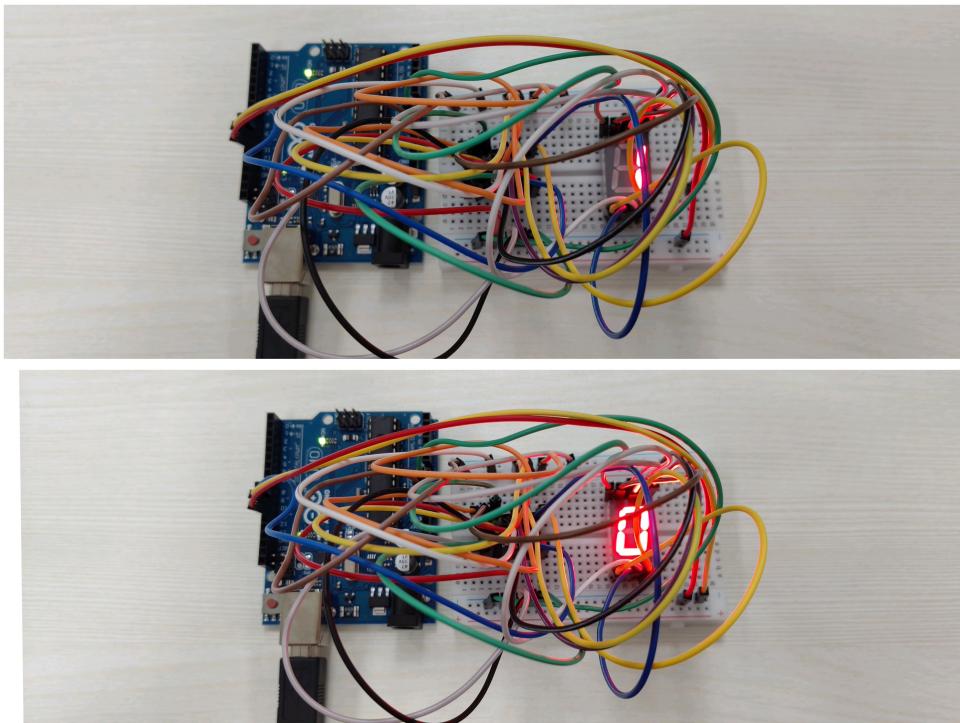
Code Uploading Steps

1. Create a Platform IO project.
2. Write the code in main.cpp inside src folder.
3. Run:
`pio run`
4. Copy the generated .hex file to Arduino Droid folder.
5. Connect Arduino UNO using OTG cable.
6. Upload using "Upload Precompiled" option.
7. Observe output and verify $Q = A\bar{B}$.

Experimental Truth Table

A	B	Observed Output
0	0	0
0	1	0
1	0	1
1	1	0

Hardware Implementation



Conclusion

From Boolean simplification, theoretical truth table, and hardware testing:

$$Q = A\bar{B}$$

Circuits (a), (b), and (c) produce same output.

Circuit (d) produces different output.

Hence the correct answer is:

(d)