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Boolean Algebra

LOGIC GATES

$A \rightarrow$ It is input or output of any digital Ckt.

$$A + 0 = A$$
$$A + 1 = 1$$
$$A \cdot 0 = 0$$
$$A \cdot 1 = A$$

$$A + A = A$$
$$A \cdot A = A$$
$$A + \overline{A} = 1$$
$$A \cdot \overline{A} = 0$$
$$\overline{\overline{A}} = A$$

$$\left.\begin{aligned} A + B &= B + A \\ A \cdot B &= B \cdot A \end{aligned}\right\} \text{Commutative property.}$$

$$\left.\begin{aligned} A + (B + C) &= (A + B) + C \\ A \cdot (B \cdot C) &= (A \cdot B) \cdot C \end{aligned}\right] \text{Associative law.}$$

$$(A + B) \cdot (C + D) = A \cdot C + A \cdot D + B \cdot C + B \cdot D$$

(Distributive)

De-Morgan's Theorem

$$\overline{A + B} = \overline{A} \cdot \overline{B}$$
$$\overline{A \cdot B} = \overline{A} + \overline{B}$$

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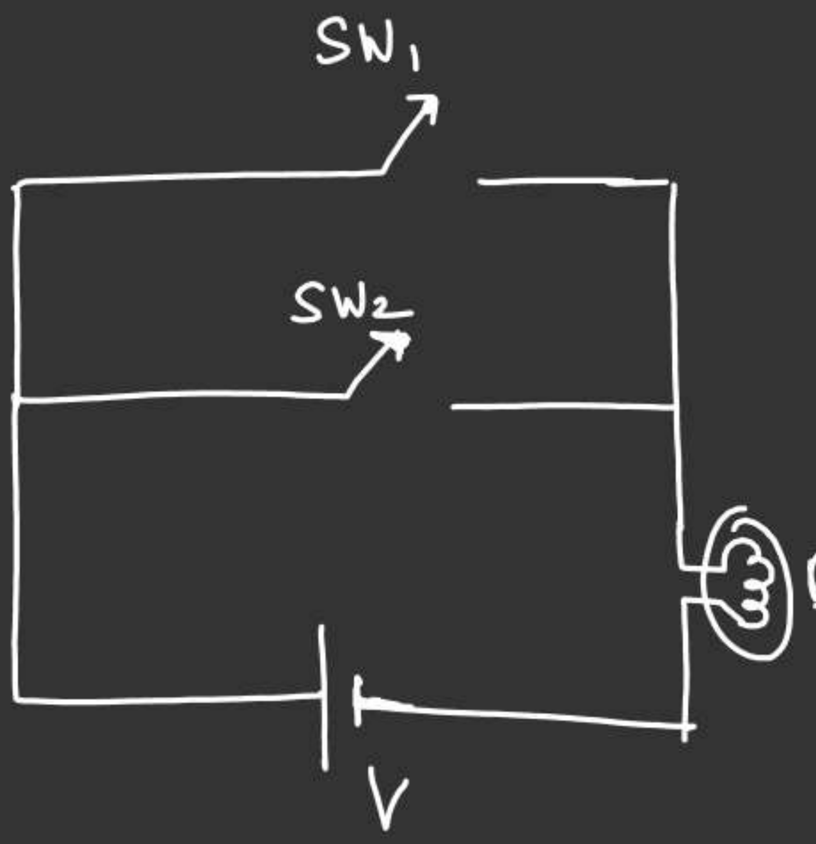
LOGIC GATES (JEE MAINS)

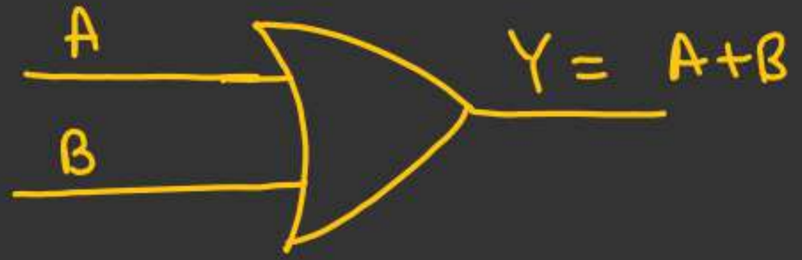
Boolean operation

OR - operation (+)



SW_1	SW_2	Bulb
open	open	Not Glow
Closed	open	Glow
open	Closed	Glow
Closed	Closed	Glow

OR GATE



TRUTH TABLE

A	B	Y = A + B
0	0	0
1	0	1
0	1	1
1	1	1

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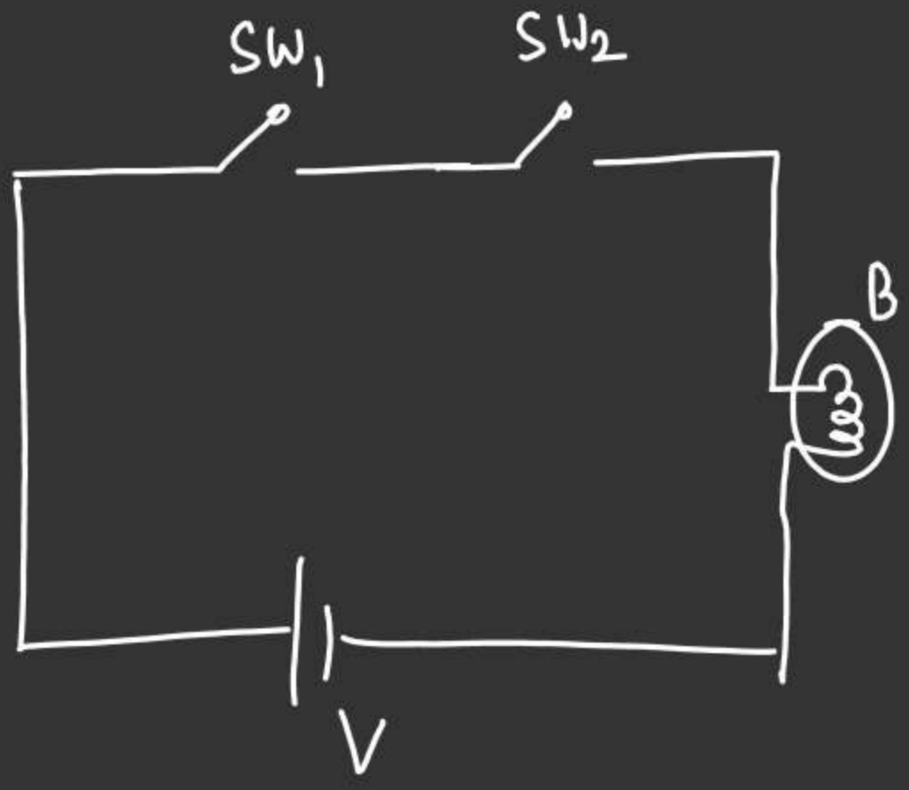
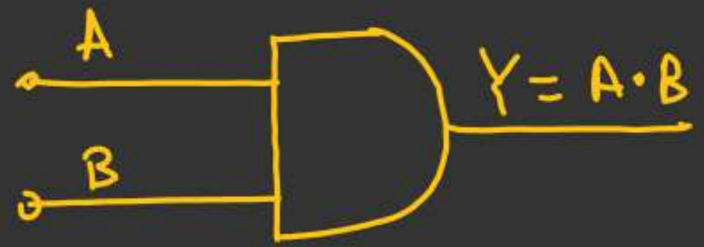
LOGIC GATES (JEE MAINS)

AND Operation (X)



SW1	SW2	Bulb
Open	Open	Not Glow
Closed	Open	Not Glow
Open	Closed	Not Glow
Closed	Closed	Glow

AND GATE

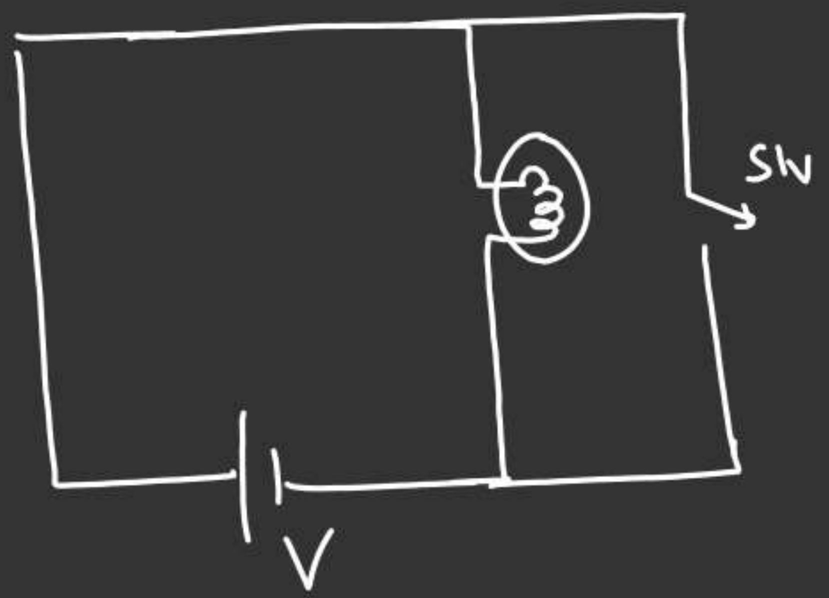


Truth table

A	B	$Y = A \cdot B$
0	0	0
1	0	0
0	1	0
1	1	1

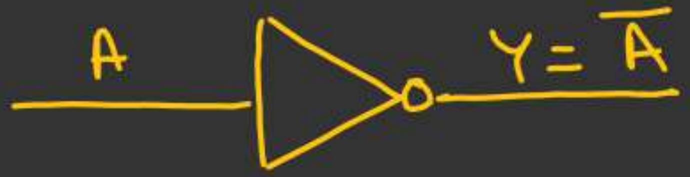
LOGIC GATES (JEE MAINS)

NOT operation (— Bar)



SW	Bulb
open	Glow.
Closed	Not Glow.

NOT- Gate

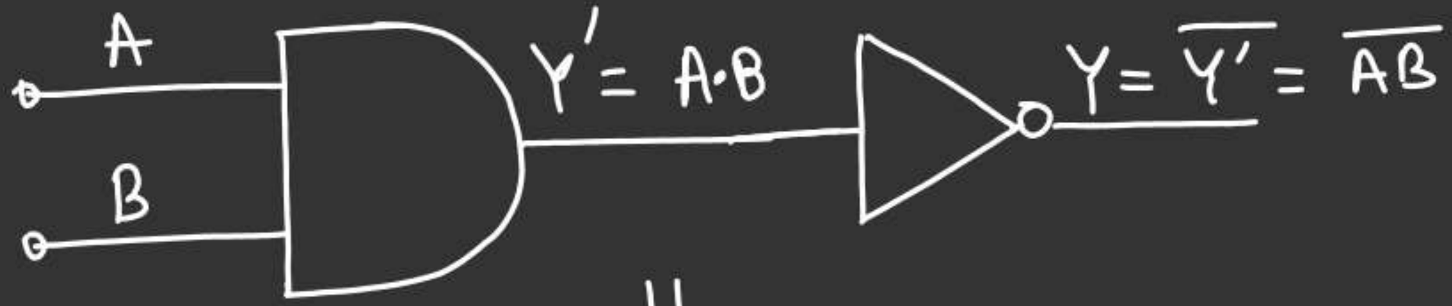


A	$Y = \bar{A}$
0	1
1	0

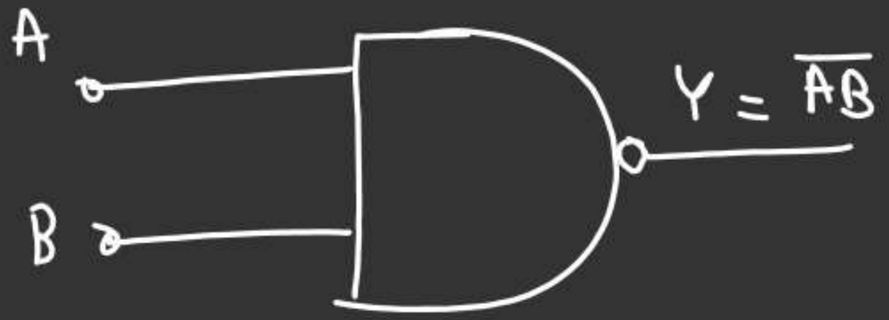
LOGIC GATES (JEE MAINS)

NAND Gate (Universal gate)

↳ (AND + NOT)



⇓



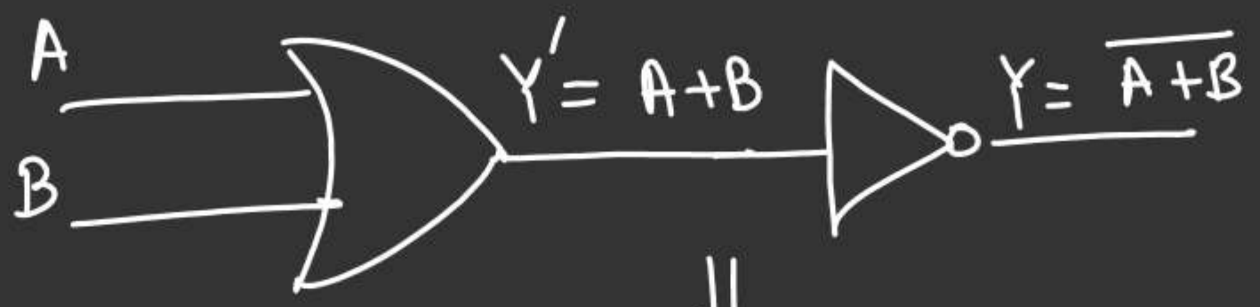
Truth table.

A	B	$Y' = A \cdot B$	$Y = \overline{AB}$
0	0	0	1
1	0	0	1
0	1	0	1
1	1	1	0

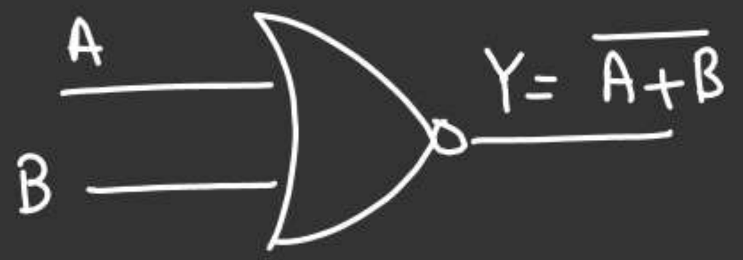
LOGIC GATES (JEE MAINS)

NOR Gate (Universal gate)

↳ [OR + NOT gate]



⇓



Truth table

A	B	$Y' = A+B$	$Y = \overline{A+B}$
0	0	0	1
1	0	1	0
0	1	1	0
1	1	1	0

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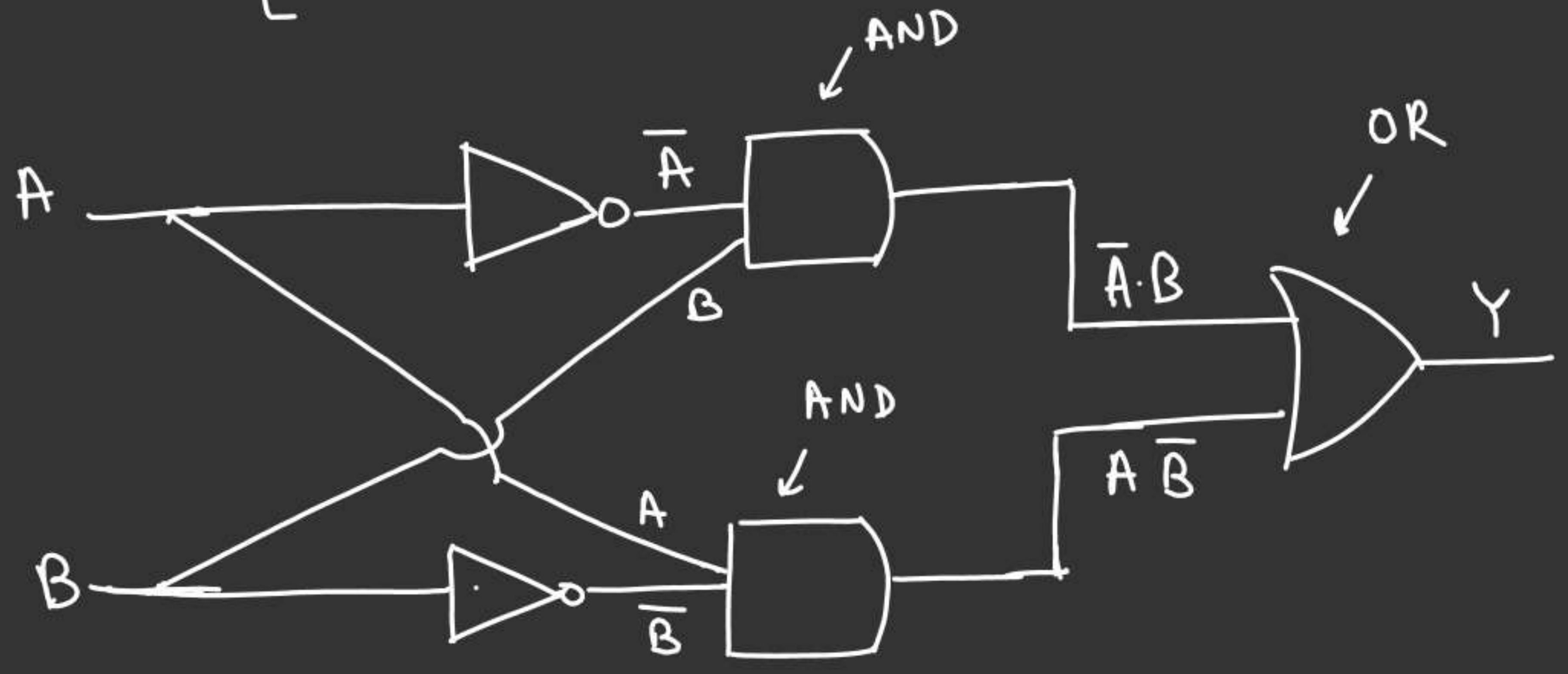
LOGIC GATES (JEE MAINS)

XOR gate

↳ [OR + AND + NOT gate]



$$Y = \left(\bar{A}B + A\bar{B}\right)$$

Truth table

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

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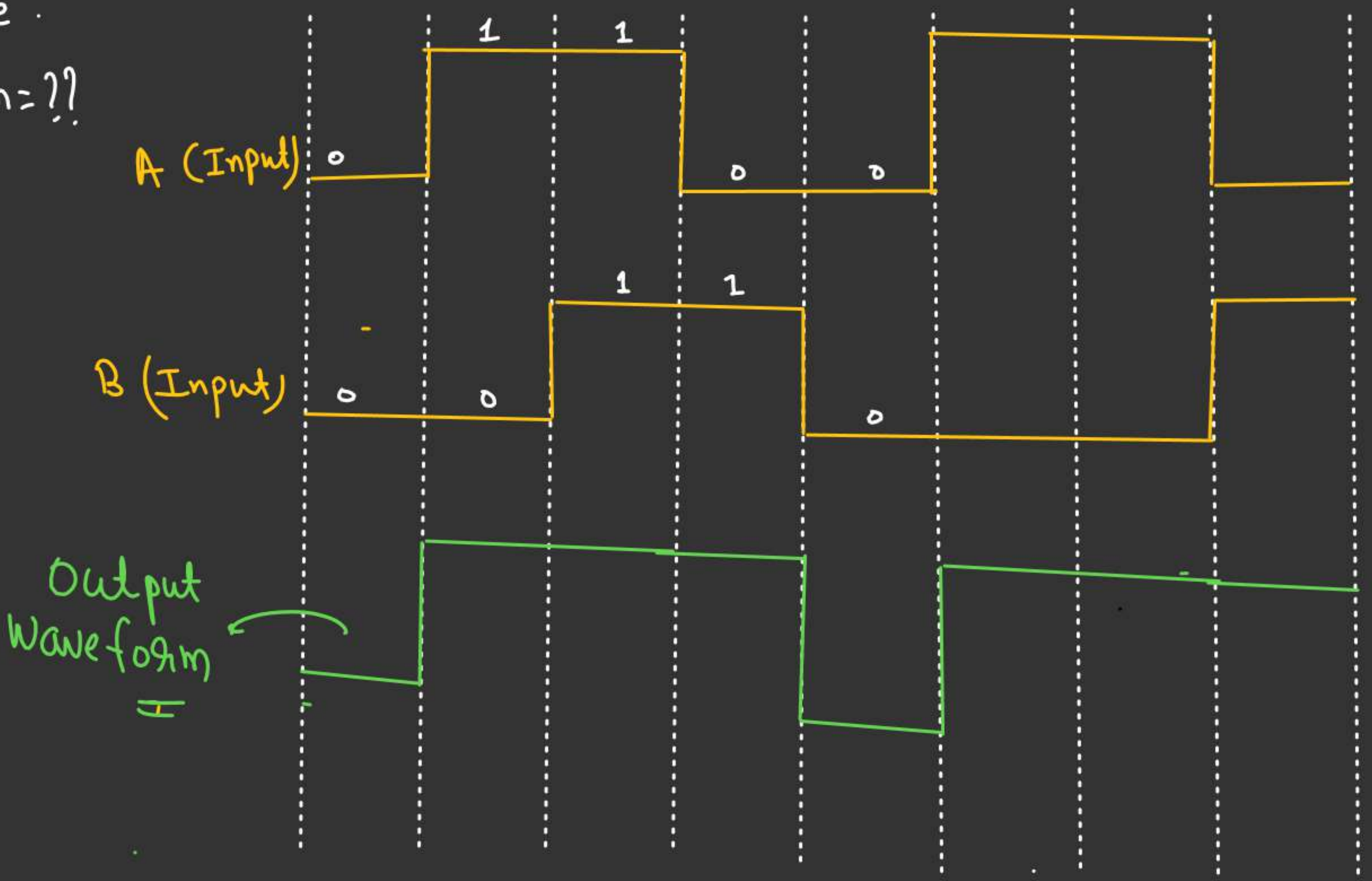
LOGIC GATES (JEE MAINS)

Q: A & B are input of OR-Gate.

output waveform = ??

$Y = \underline{A+B}$



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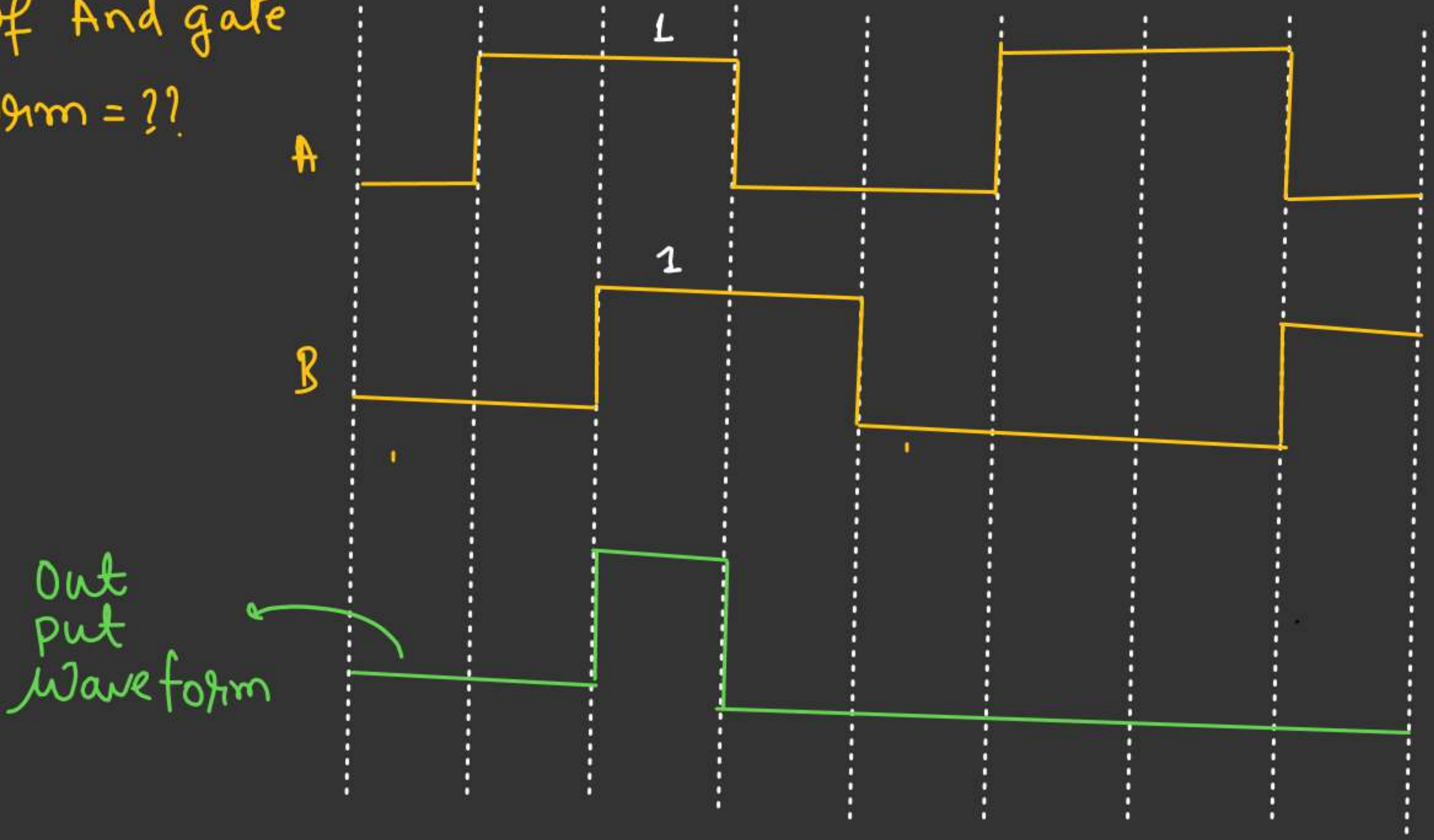
LOGIC GATES (JEE MAINS)

Q: AND GATE

A & B input of And gate

output wave form = ??

$Y = A \cdot B$



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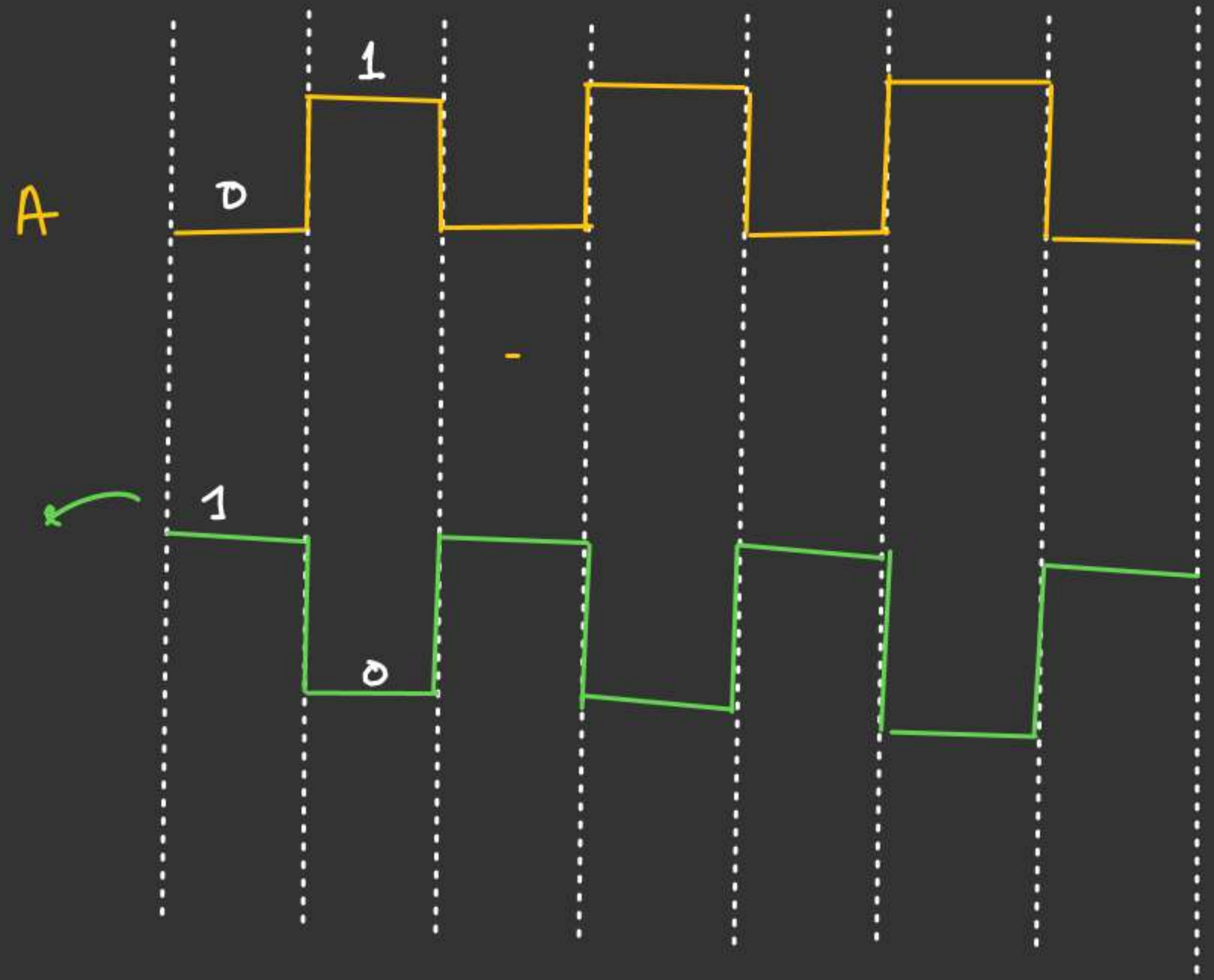
NOT- Gate

$Y = \overline{A}$



Output

$Y = \overline{A}$

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LOGIC GATE

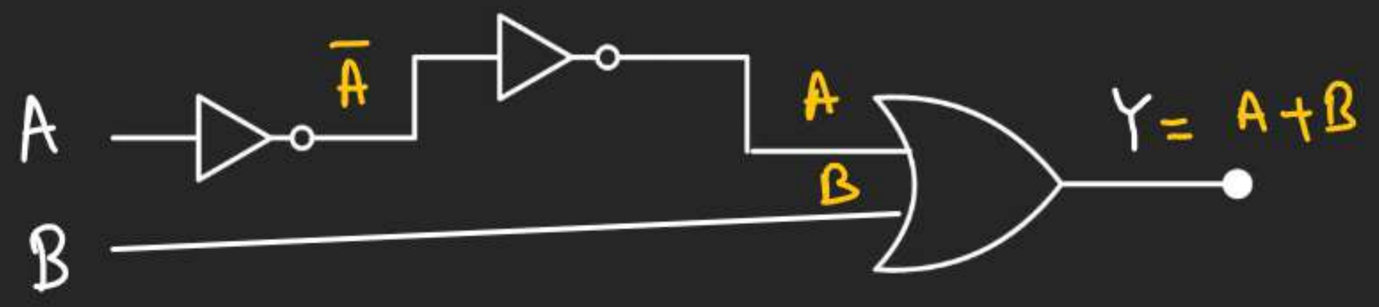
Q.1 Identify the gate from the following:

(A) NOT gate

(B) AND gate

(C) OR gate ✓

(D) None of these



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Q.2 Which of the following is not correct?

(A) $\overline{\bar{A} \cdot \bar{B}} = A + B$

(B) $\overline{\bar{A} \cdot \bar{B}} = A \cdot B$

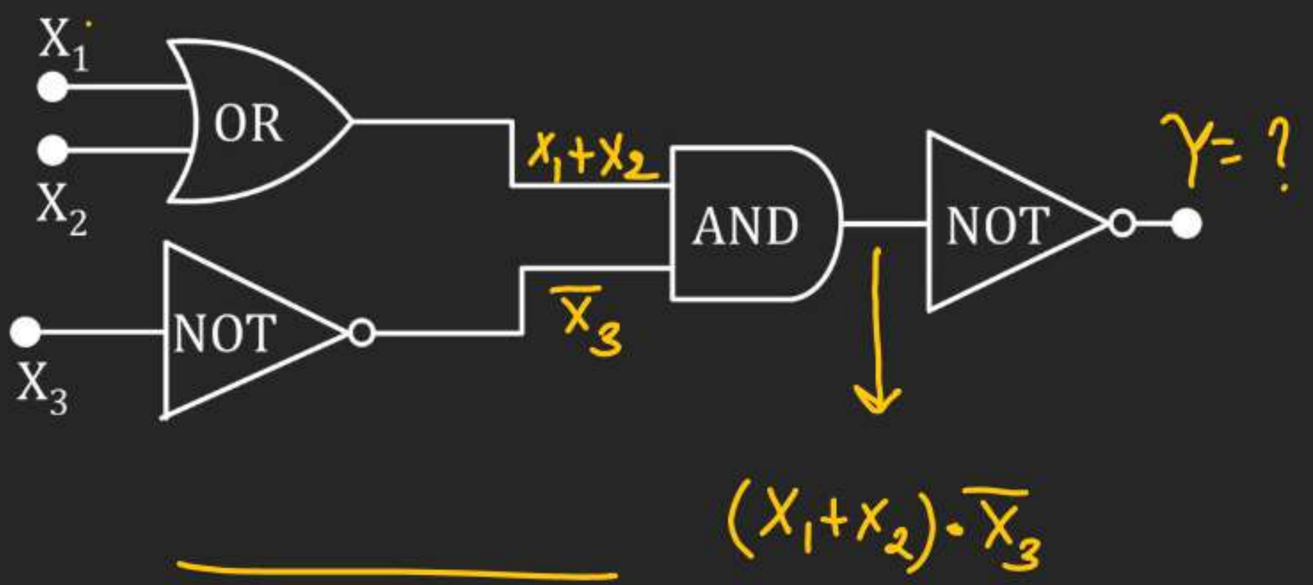
(C) $\overline{\overline{(A \cdot B)} \cdot \overline{(A \cdot B)}} = AB + AB$

(D) $\bar{1} + \bar{1} = 1$

LOGIC GATE

Q.3 For the given logic circuit,

Which of these is correct?



(A) $y = 0$ for $X_1 = X_3 = 0$ and $X_2 = 1$

(B) $y = 0$ for $X_1 = X_2 = X_3 = 0$

(C) $y = 1$ for $X_1 = X_2 = X_3 = 1$

(D) $y = 1$ for $X_1 = X_2 = 1$ and $X_3 = 0$

$$\overline{A\cdot B} = \overline{A} + \overline{B}$$

$$\overline{A+B} = \overline{A}\cdot\overline{B}$$

$$Y = \overline{\underbrace{(X_1+X_2)}_{A}\cdot\underbrace{\overline{X_3}}_{B}}$$

$$Y = \overline{X_1+X_2} + \overline{\overline{X_3}}$$

$$Y = (\overline{X_1}\cdot\overline{X_2} + X_3)$$

LOGIC GATE

Q.4 In the Boolean algebra, $(\overline{\bar{A} \cdot \bar{B}}) \cdot A$ equals to

(A) $\overline{A + B}$

(B) A ✓

(C) $\overline{A \cdot B}$

(D) $A + B$

$$= (\overline{\bar{A} \cdot \bar{B}}) \cdot A$$

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

$$= (A + B) \cdot A$$

$$= A \cdot A + BA$$

$$= A + BA$$

$$= A(\underbrace{B+1}_{1})$$

$$= \underline{\underline{A}}$$

LOGIC GATE

Q.5 In order to obtain an output $Y = 1$ from the circuit of figure, the inputs must be

	A	B	C
(1)	0	1	0
(2)	1	0	0
(3)	1	0	1
(4)	1	1	0

$$Y = (A+B)\cdot C$$

LOGIC GATE

Q.6 With reference to figure, which of the following is possible?

(A) $A = 0, B = 0, X = 1$

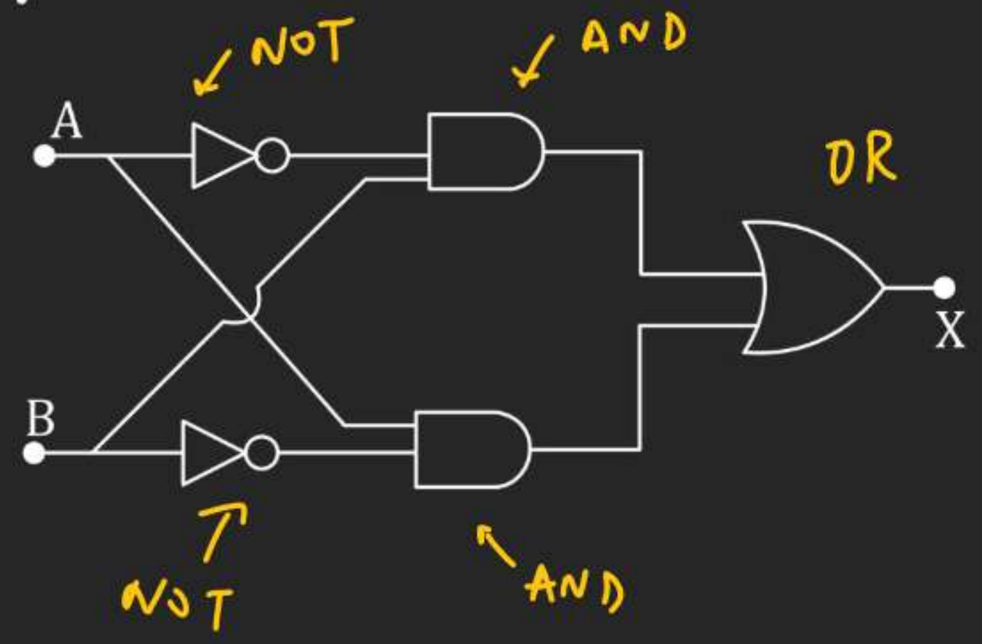
(B) $A = 0, B = 1, X = 0$

(C) $A = 0, B = 0, X = 0$

(D) $A = 1, B = 1, X = 0$

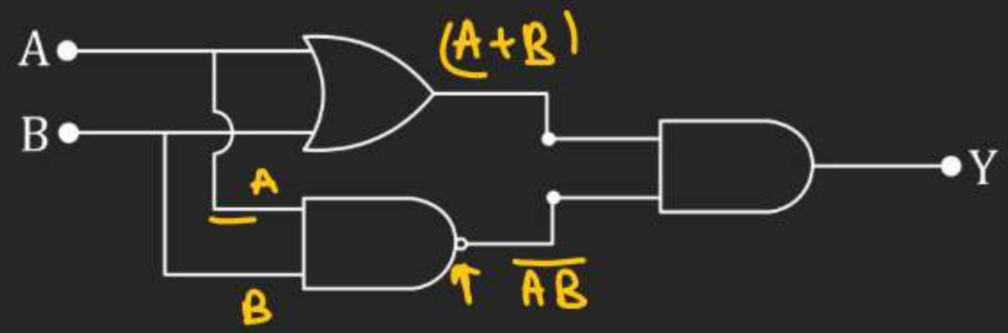
XOR - Gate

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



LOGIC GATE

Q.7 **Name the gate represented by the following circuit:**



(1) OR gate

(2) XOR gate ✓

(3) AND gate

(4) NAND gate

$$Y = (A+B)\cdot(\overline{AB})$$

$$Y = (A+B)\cdot(\bar{A}+\bar{B})$$

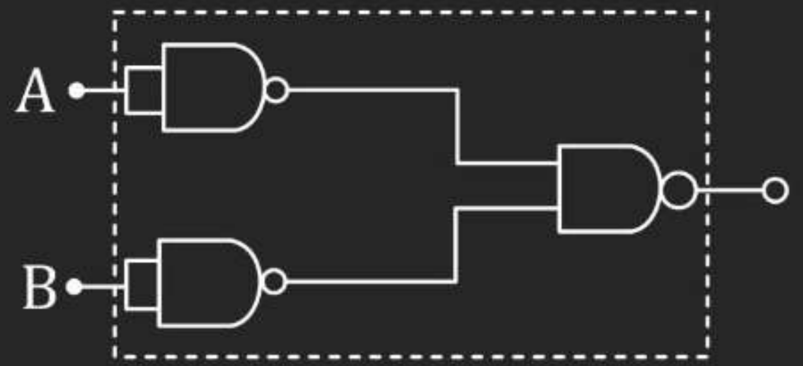
$$Y = \underbrace{A\cdot\bar{A}}_{0} + A\bar{B} + B\bar{A} + \underbrace{B\bar{B}}_{0}$$

$$Y = \underline{A\bar{B} + B\bar{A}}$$

H-W

LOGIC GATE

Q.8 The combination of 'NAND' gates shown here under (figure) are equivalent to



(A) An OR gate and an AND gate respectively

(B) An AND gate and a NOT gate respectively

(C) An AND gate and an OR gate respectively

(D) An OR gate and a NOT gate respectively.

H-W

LOGIC GATE

Q.9 The following truth table corresponds to the logic gate where A and B represent inputs and X represents output.

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

(A) NAND

(B) AND

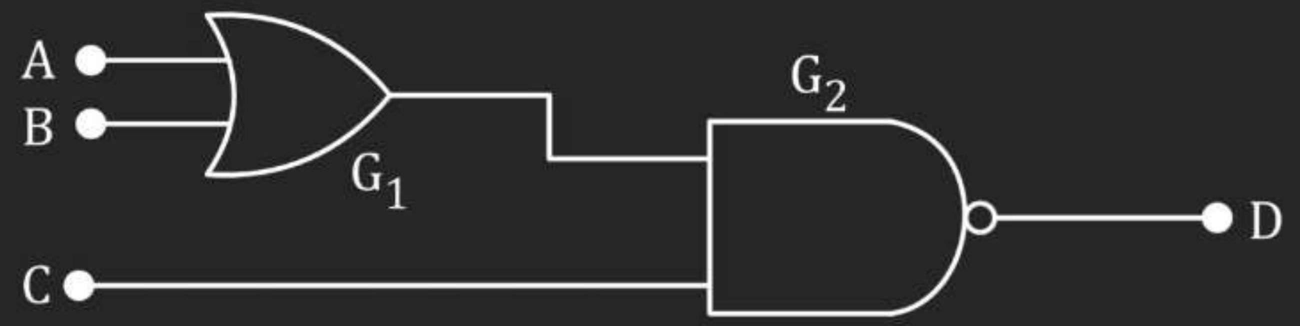
(C) XOR

(D) OR

LOGIC GATE

H.W

Q.10 For the given combination of gates, if the logic states of inputs A, B, C are as follows $A = B = C = 0$ and $A = B = 1$, $C = 0$, then the logic states of output D are



(A) 0,0

(B) 0,1

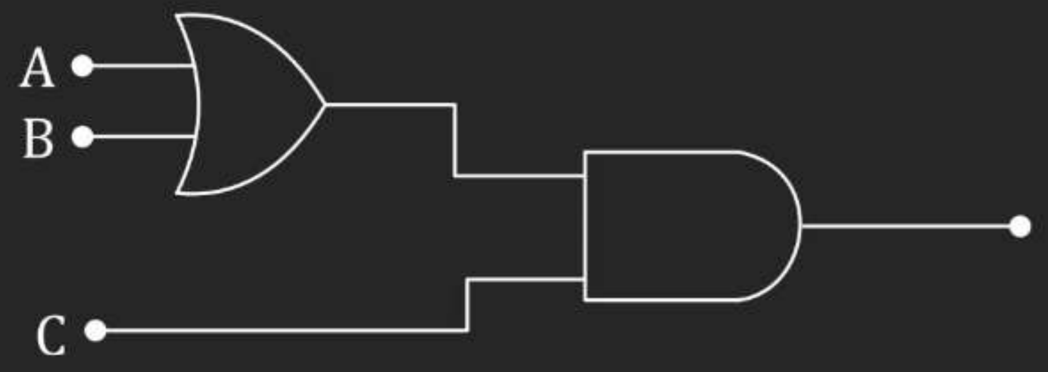
(C) 1,0

(D) 1,1

H.W

LOGIC GATE

Q.11 To get an output 1 from the circuit shown in the figure, the input must be



(A) $A = 0, B = 1, C = 0$

(B) $A = 1, B = 0, C = 0$

(C) $A = 1, B = 0, C = 1$

(D) $A = 1, B = 1, C = 0$

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LOGIC GATE

H.W

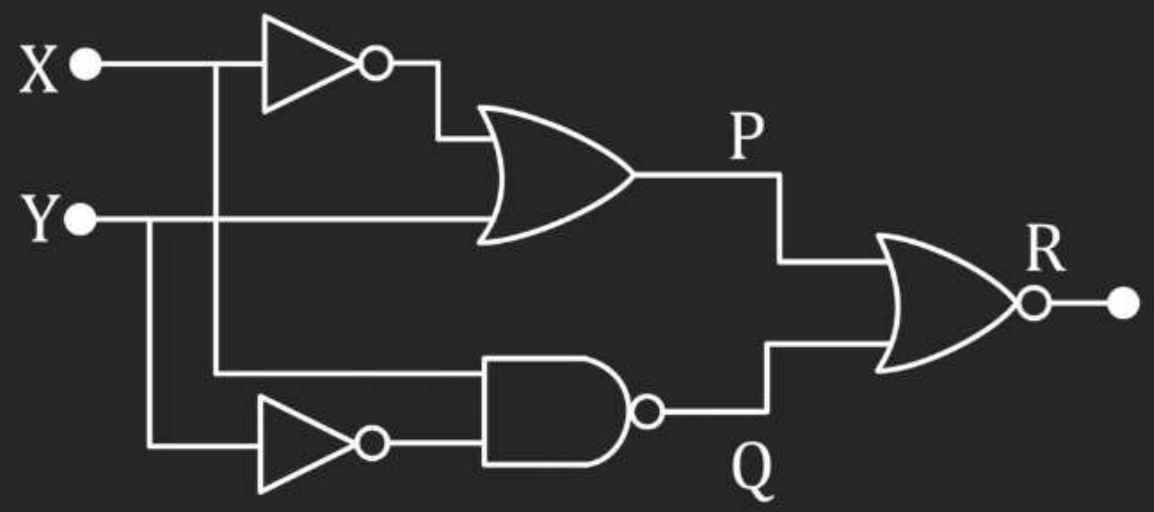
Q.12 The figure below gives a system of logic gates. From the study of truth table, it can be found that to produce a high output (1) at R, we must have

(A) $X = 0, Y = 1$

(B) $X = 1, Y = 1$

(C) $X = 1, Y = 0$

(D) $X = 0, Y = 0$



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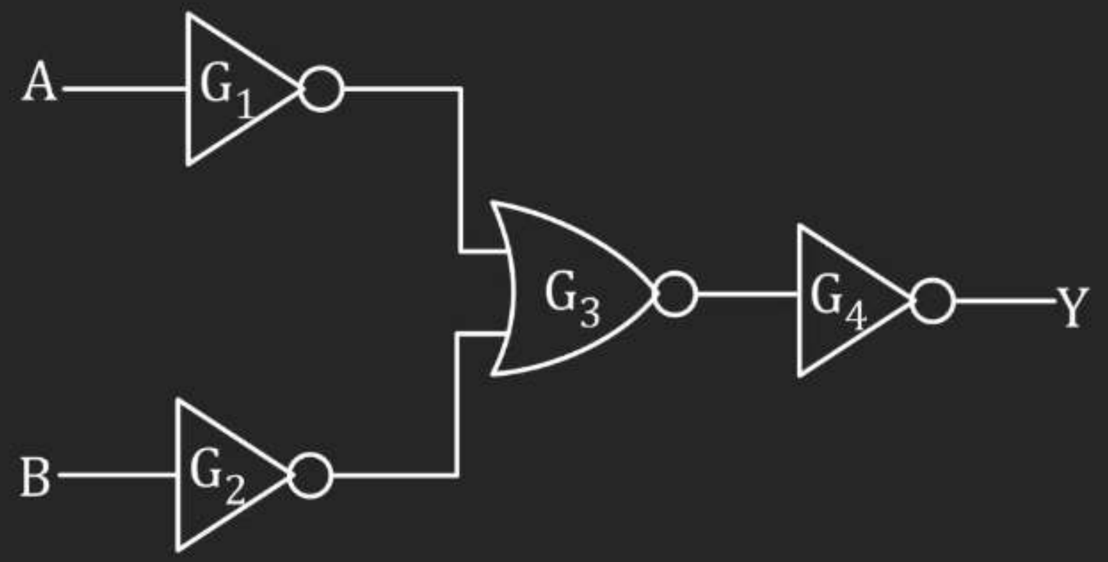
LOGIC GATE

H-W

Q.13 The combination of gates shown below produces



(A) AND gate

(B) XOR gate

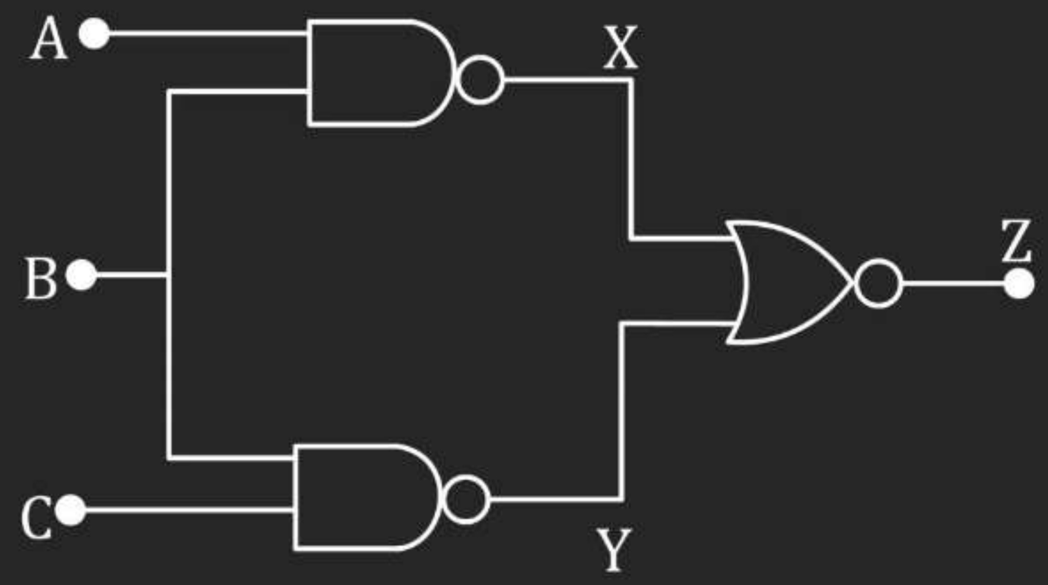
(C) NOR gate

(D) NAND gate

H.W

LOGIC GATE

Q.14 The figure shows two NAND gates followed by a NOR gate. The system is equivalent to the following logic gate



(A) OR

(B) AND

(C) NAND

(D) None of these