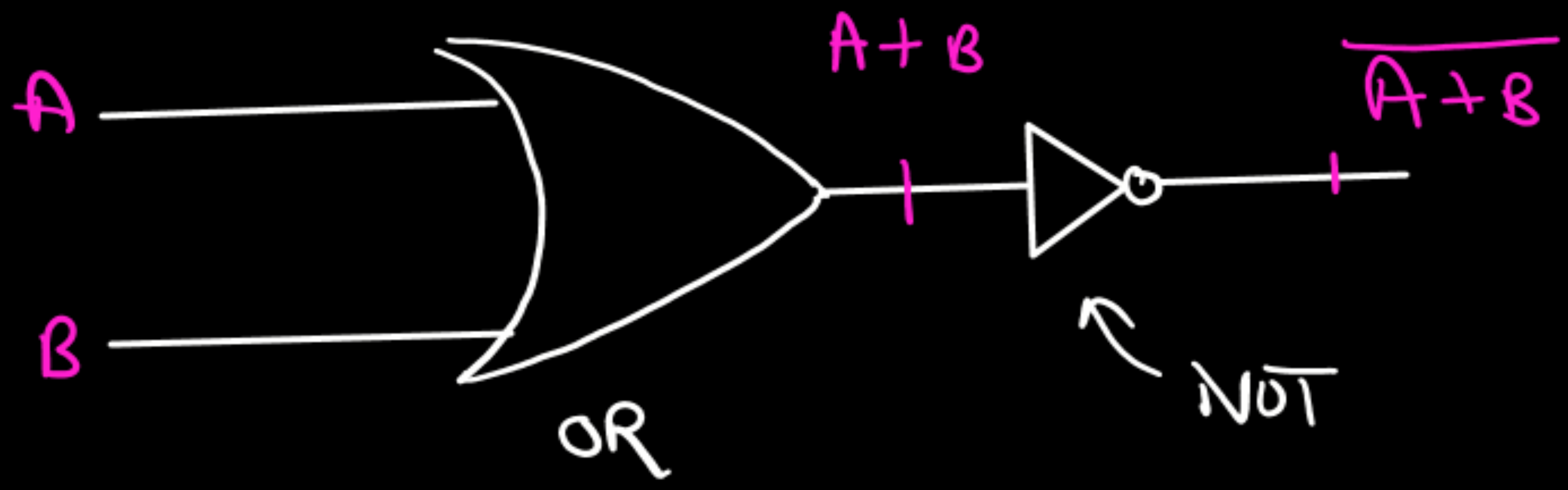
NOR Gate:

↳ OR → Inverter (NOT)

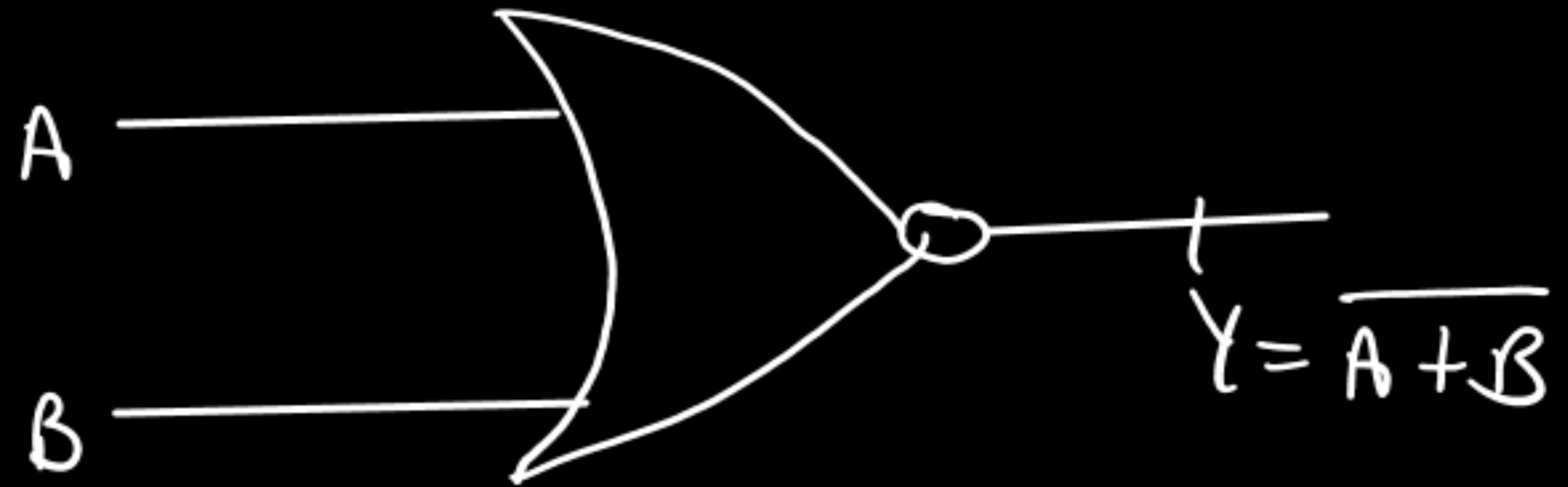
* o/p is high when both inputs are low

OR — +

AND — ·



$Y = \overline{A+B}$



* The output of NOR Gate is inversion of OR Gate

Truth Table

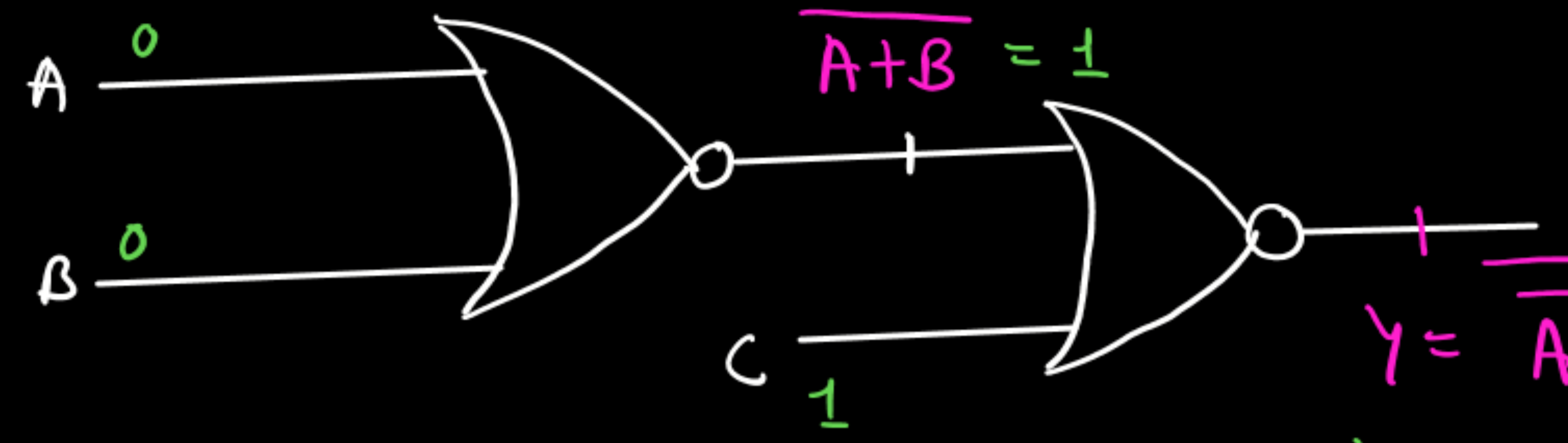
A	B	A+B	$\overline{A+B}$
0	0	0	1
0	1	1	0
1	0	1	0
1	1	1	0

* Commutative Law

↳ $\overline{A+B} = \overline{B+A}$

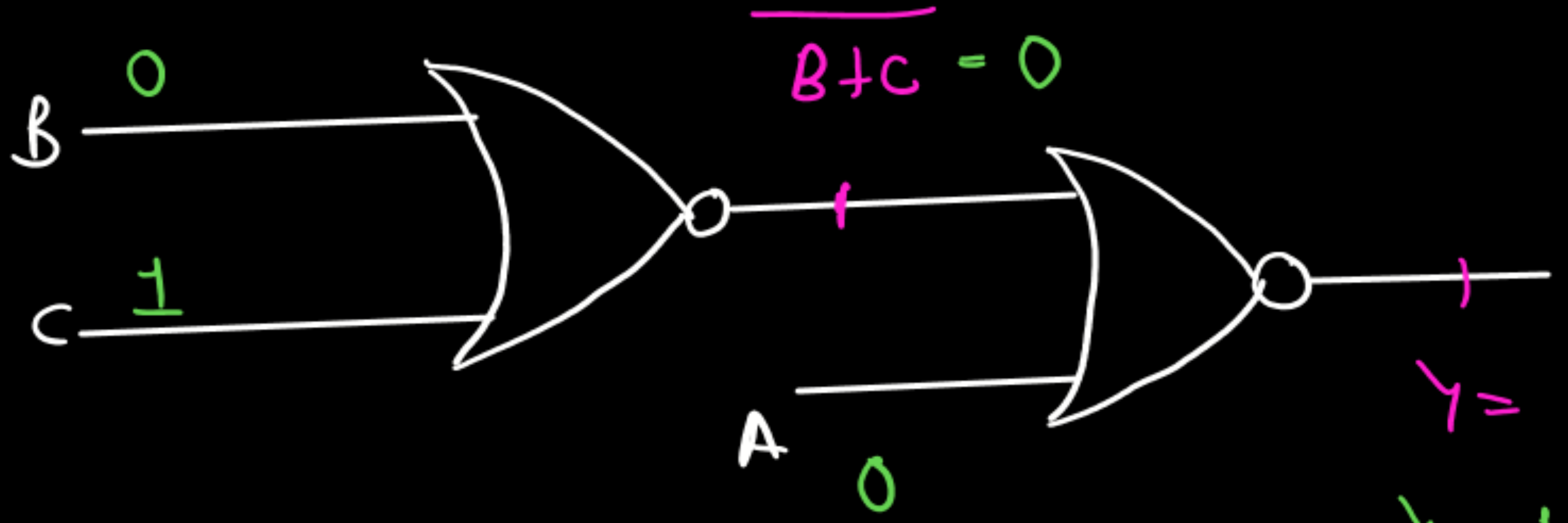
Associative Law

$A = 0 \quad B = 0, \; C = 1$



$Y = \overline{\overline{A+B} + C}$

$Y = 0$



$Y = \overline{\overline{B+C} + A}$

$Y = 1$

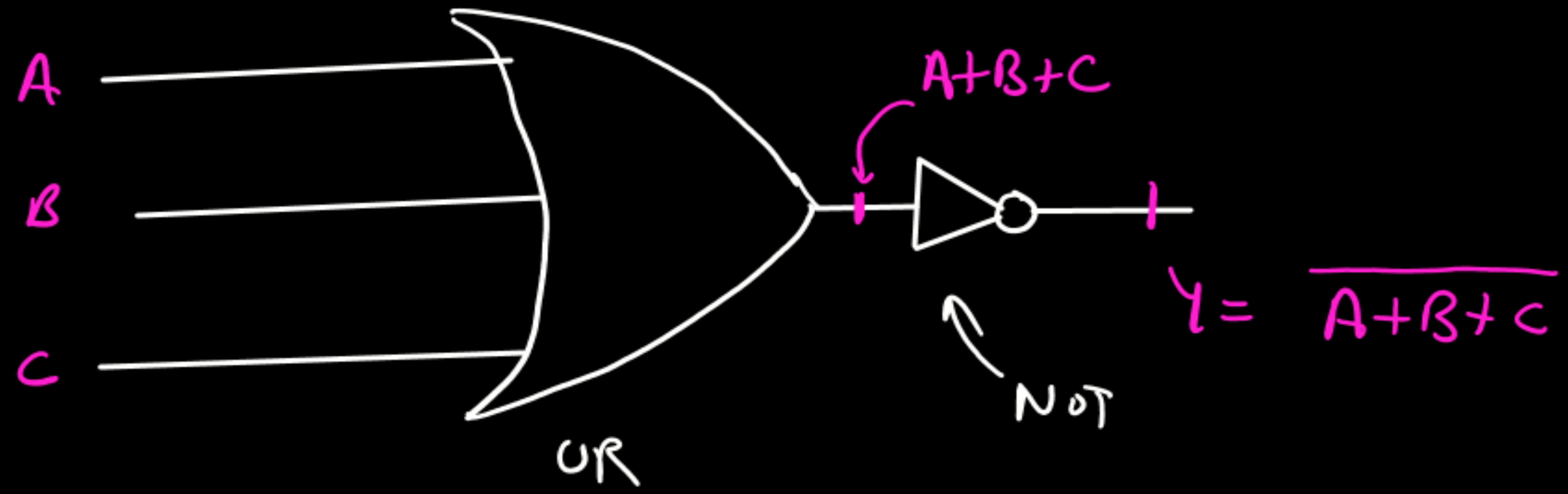
* NOR Gate does NOT follow law of associativity

$$\overline{\overline{A+B} + C} \neq \overline{\overline{B+C} + A}$$

* NAND & NOR $\neq$ Associative Law

3 input NOR Gate

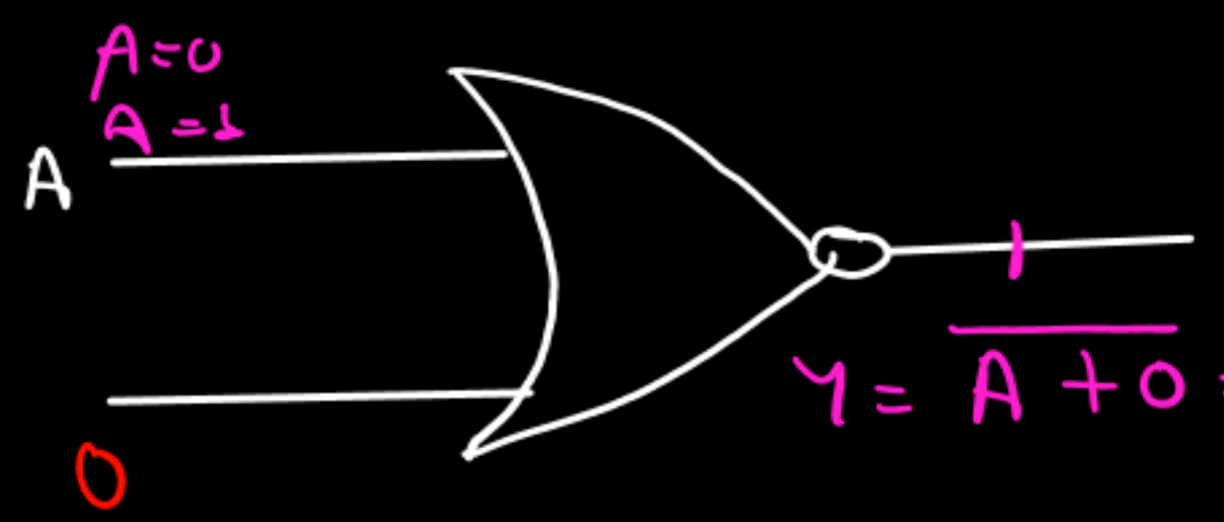
↳ 3 i/p OR Gate + 1 Inverter



Truth Table

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

Enabled & Disabled NOR



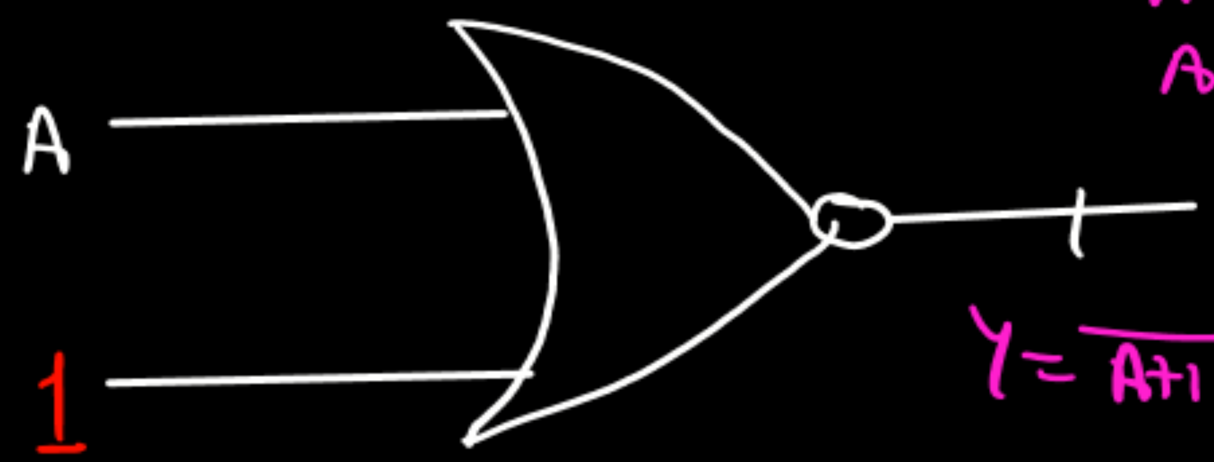
$Y = \overline{A+0} =$

$$\left.\begin{array}{l} A=0,\ Y=1 \\ A=1,\ Y=0 \end{array}\right\} Y=\bar{A}$$

* O/P is dependent on I/P
  - ↳ Enabled NOR Gate
    - ↳ $Y=\bar{A}$ } Act like an inverter

$A=0,\ \overline{0+1} = \bar{1} = 0$

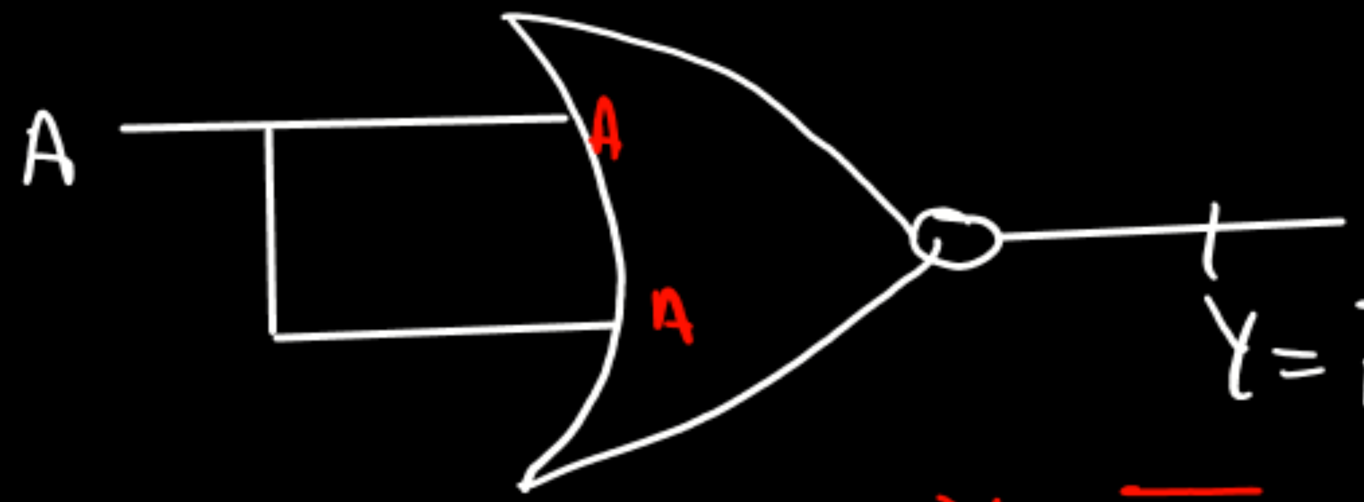
$A=1,\ \overline{1+1} = \bar{1} = 0$



$Y = \overline{A+1} =$

* The o/p is stable at '0'. There is no dependency of o/p on input
  - ↳ Disable NOR Gate

Floating I/P NOR Gate



$Y = \overline{A+B}$

$Y = \overline{A+A}$

$$\left.\begin{array}{l} A=0,\ Y=\overline{0+0}=\bar{0}=1 \\ A=1,\ Y=\overline{1+1}=\bar{1}=0 \end{array}\right\} Y=\bar{A}$$

↳ Act like an Inverter (NOT)

Properties of NOR Gate:

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

2) $\overline{A+1} = \overline{1} = 0$

3) $\overline{A+A} = \overline{A}$

4) $\overline{A+\overline{A}} = \overline{1} = 0$

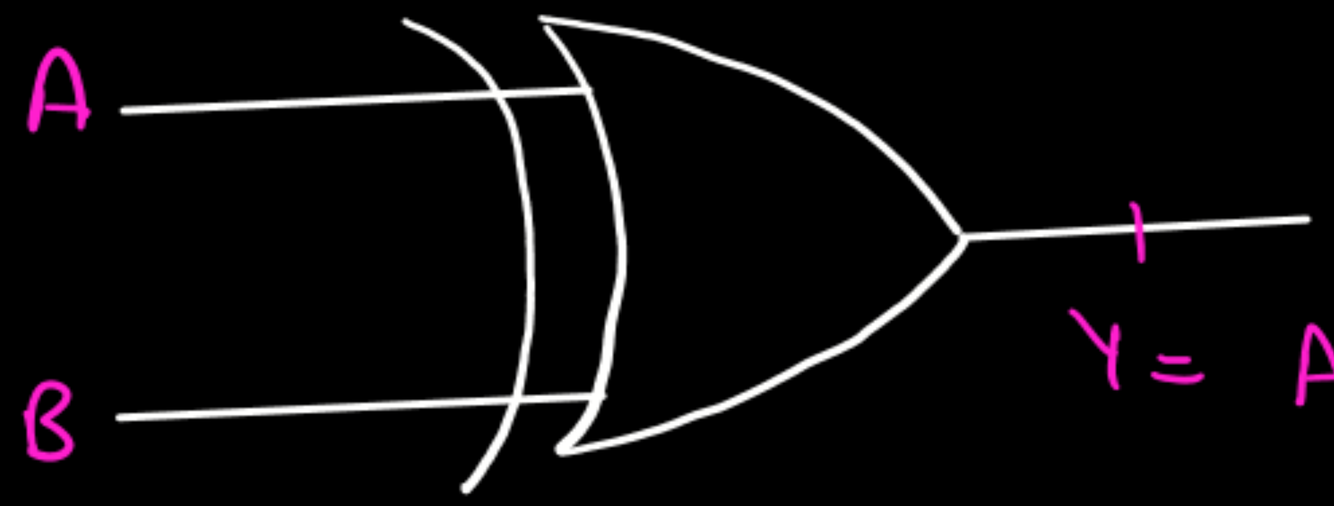
XOR Gate:

↳ Ex-OR (Exclusive OR)

* Also Called as Inequility Detector

↳ O/P = 1, when both Inputs are unequal

O/P = 0, when both Inputs are equal



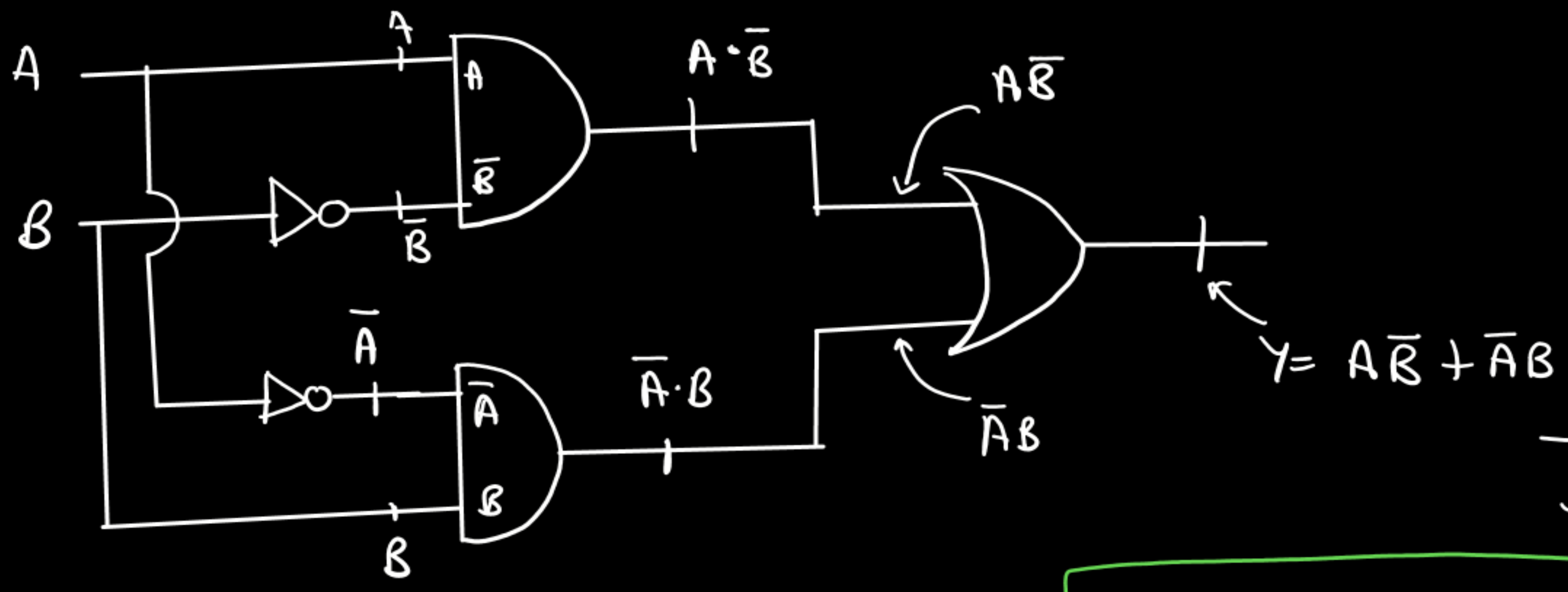
$Y = A\bar{B} + \bar{A}B$

XOR Symbol → $A \oplus B$

XOR

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

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



Truth Table

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

a) Commutative law :

$$\boxed{A \oplus B = B \oplus A}$$

b) Associative law :

$$(A \oplus B) \oplus C = A \oplus (B \oplus C)$$

Yes Possible

* 3 input XOR Gate : Output = 1, if odd number of 1's are present in input

A	B	C	$Y = A \oplus B \oplus C$
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1

Even no. of 1's are present at input

Properties of XOR Gate:

1) $A \oplus 0 = A$

$\hookrightarrow$ $A = A$, $B = 0$

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

2) $A \oplus 1 = \bar{A}$

$\hookrightarrow$ $A = 1$, $B = 1$

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

3) $A \oplus A = 0$

4) $A \oplus \bar{A} = 1$

$A = 0$, $\bar{A} = 1$, $0 \oplus 1 = 1$

$A = 1$, $\bar{A} = 0$, $1 \oplus 0 = 1$

5) if $A \oplus B = C$

then, $A \oplus C = B$

$B \oplus C = A$

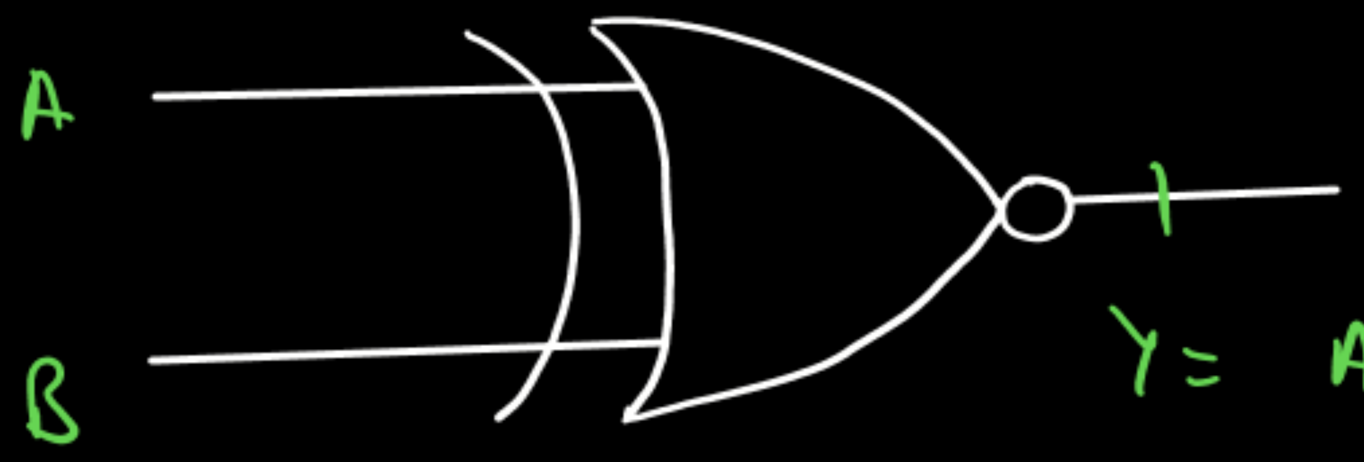
$\Rightarrow$ It is cyclic.

XNOR Gate:

↳ Ex-NOR (Exclusive NOR)

→ Equility Detector

↳ when both inputs are equal then o/p = high



$Y = A \odot B$

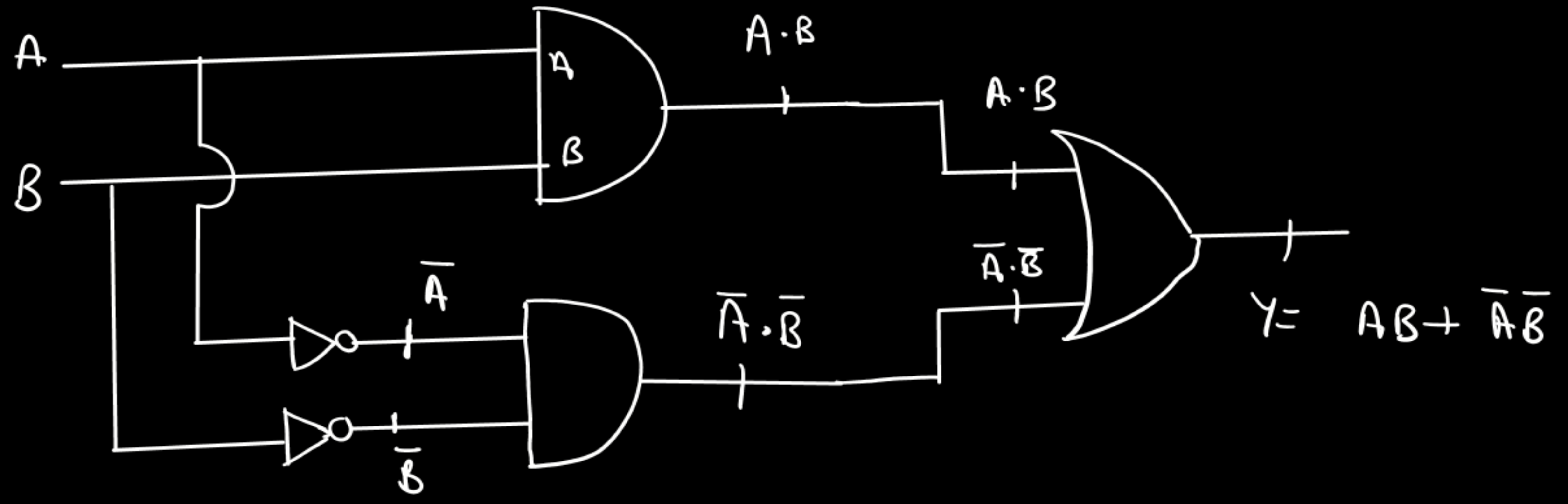
$A \odot B = AB + \overline{A}\,\overline{B}$

← Logical Expression

Truth Table

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

$Y = AB + \bar{A}\bar{B} \Rightarrow A \cdot B + \bar{A} \cdot \bar{B}$



} Logic Diagram

a) <u>Commutative Law:</u> $\boxed{A \odot B = B \odot A}$

b) <u>Associative Law:</u>

$$(A \odot B) \odot C = A \odot (B \odot C)$$

Properties of XNOR Gate :

a) $A \odot 0 = \bar{A}$

$\hookrightarrow A = A,\ B = 0$

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

$= \bar{A} \cdot 1 = \bar{A}$

b) $A \odot 1 = A$

$\hookrightarrow A = A,\ B = 1$

$Y = AB + \bar{A}\bar{B} \Rightarrow A \cdot 1 + \bar{A} \cdot \bar{1}$

$\Rightarrow A \cdot 1 + \cancel{\bar{A} \cdot 0} = A \cdot 1 = A$

c) $A \odot A = 1$

Equality detector

d) $A \odot \bar{A} = 0$

Both I/p are unequal

Let $y = A \odot B \odot C$

↳ 3 input XNOR Gate is same as 3 input XOR operation

* for multiple inputs, XOR searches for odd number of 1's

But XNOR gate searches for even number of 0's

* for odd number of input

↳ odd number of 1's will be same as even no. of zeroes

$$\boxed{XNOR = XOR}$$

* for even number of input,

$$\boxed{XNOR = \overline{XOR}}$$