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Unit - 9C (GATES)

Q1. a) What are logic Gates? Name various types of Gates.

b) Discuss symbol, Boolean expression (Equation) and Truth Table of different Gates.

Ans: a) Logic gates:- A digital circuit which either allows a signal to pass through or stops it, when some logical conditions are satisfied called logic gates.

b) Various types of gates are:-

a) NOT Gate

b) OR Gate

c) AND Gate

d) NOR Gate

e) NAND Gate

f) XOR Gate

g) X – NOR Gate

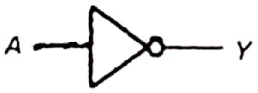
+2 / Unit 9C / Q1 Types of Gates

* NOR Gate and NAND Gate are called digital building block Gates.

Q2. Discuss Symbol, Boolean expression and Truth Table of Gates.

Ans. a) NOT Gate

Step1 Symbol



Step2 Equation or Boolean Expression

$Y = \overline{A}$ (Read Y is compliment of A)

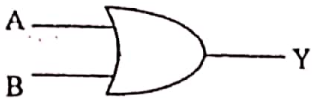
Step3 Truth Table

A	Y
0	1
1	0

+2 / Unit 9C / Symbol Boolean Expression Truth Table Theorems Numericals

b) OR Gate

Step1 Symbol



Step2 Equation

$Y = A + B$ [Read A ored with B]

Step3 Truth Table

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

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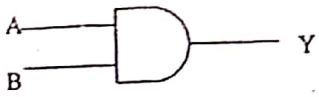
c) AND Gate

Step1 Symbol



Step2 Equation

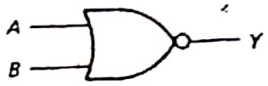
$Y = A.B$ [Read A anded with B]

Step3 Truth table

A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

d) NOR Gate

Step1 Symbol



Step2 Equation

$Y = \overline{A + B}$

Step3 Truth Table

A	B	Y
0	0	1
0	1	0
1	0	0
1	1	0

e) NAND Gate

Step1 Symbol

Step2 Equation

$Y = \overline{A.B}$

Step3 Truth Table

A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

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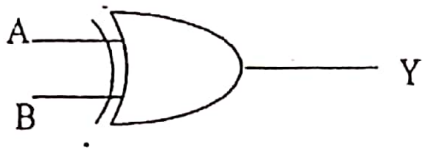
f) XOR Gate

Step1 Symbol



Step2

Step3 $Y = \bar{A}.B + A.\bar{B}$

Truth Table

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

Differs from OR Gate only because of last step.

g) X – NOR Gate

Step1 Symbol

Step2 Equation

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

Step3 Truth Table

A	B	Y
0	0	1
0	1	0
1	0	0
1	1	1

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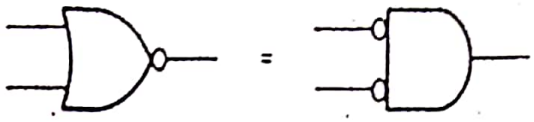
Important Theorems

1. De Morgan's first theorem

a)



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

c)

Truth Table

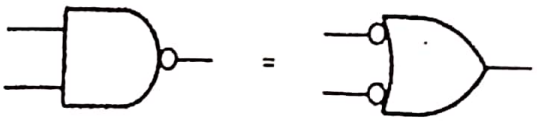
A	B	Y
0	0	1
0	1	0
1	0	0
1	1	0

Truth Table

A	B	Y
0	0	1
0	1	0
1	0	0
1	1	0

2) De Morgan's second theorem

a)



b) $\overline{A.B} = \overline{A} + \overline{B}$

c)

Truth Table

A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

Truth Table

A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

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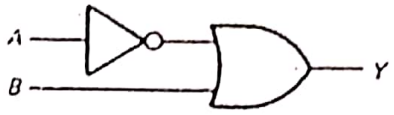
PROBLEMS – LOGIC GATES

Pr.1) Write equation and make truth table of given circuit.



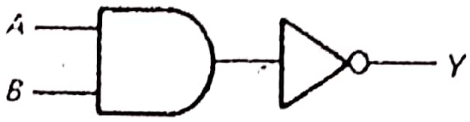
Solution:-

Equation $\boxed{Y = \overline{A} + B}$

Truth Table

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

Pr.2) Write equation and make truth table of given circuit.



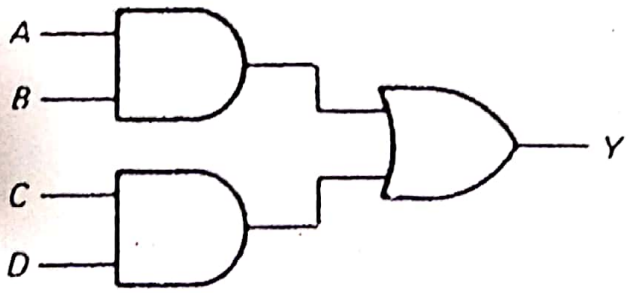
Solution:-

Equation $\boxed{Y = \overline{A.B}}$

Truth Table

A	B	$Y = \overline{A.B}$
0	0	1
0	1	1
1	0	1
1	1	0

Pr.3) Write equation and make truth table of given circuit.



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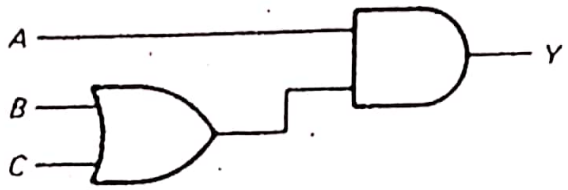
Solution:

Equation $\boxed{Y = AB + CD}$

Truth Table

A	B	C	D	Y = AB + CD
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	1
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	1
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	1
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

Pr.4) Write equation and make truth table of given circuit.



Solution:

Equation $\boxed{Y = A\,(B + C)}$

Truth Table

A	B	C	Y=A(B+C)
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

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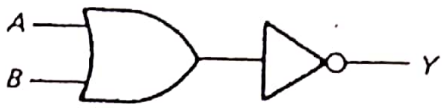
Pr.5) Write equation and make truth table of given circuit.



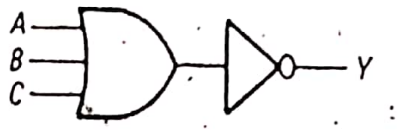
Solution:

Equation $\boxed{Y = (\overline{A + B})}$

Truth Table

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

Pr.6) Write equation and make truth table of given circuit.



Solution:

Equation $\boxed{Y = (\overline{A + B + C})}$

Truth Table

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

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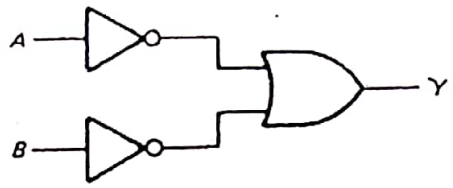
Pr.7) Write equation and make truth table of given circuit.



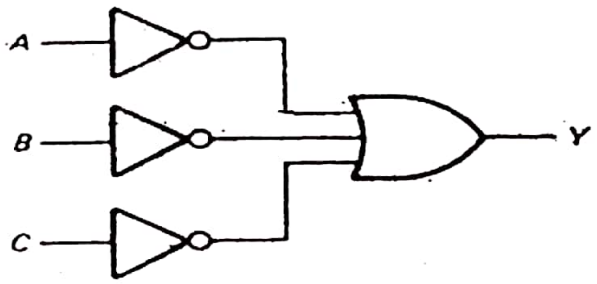
Solution:

Equation $\boxed{Y = \overline{A} + \overline{B}}$

Truth Table

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

Pr.8) Write equation and make truth table of given circuit.



Solution

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

Truth Table

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

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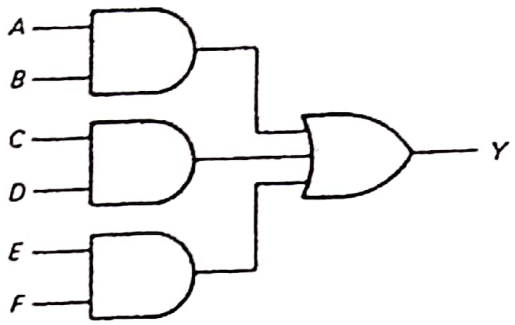
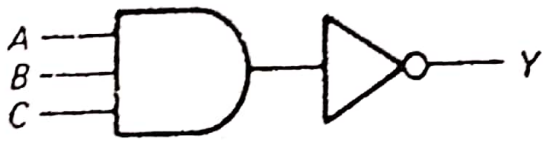
Pr.9 Write equation of given circuit.



Solution:

Equation $\boxed{Y = AB + CD + EF}$

Pr.10 Write equation and make truth table of given circuit.



Solution:

Equation $\boxed{Y = \overline{A.B.C}}$

Truth table

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

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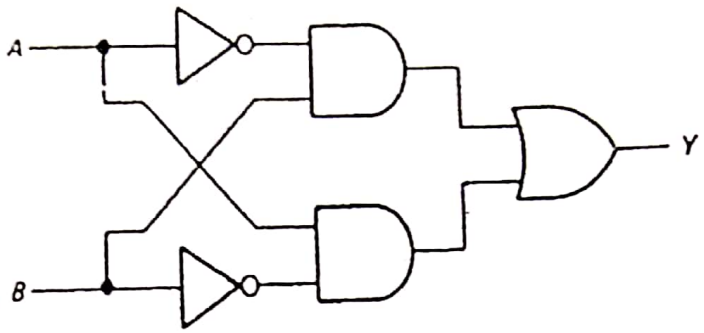
Pr.11 Write equation and make truth table of given circuit.



Solution:

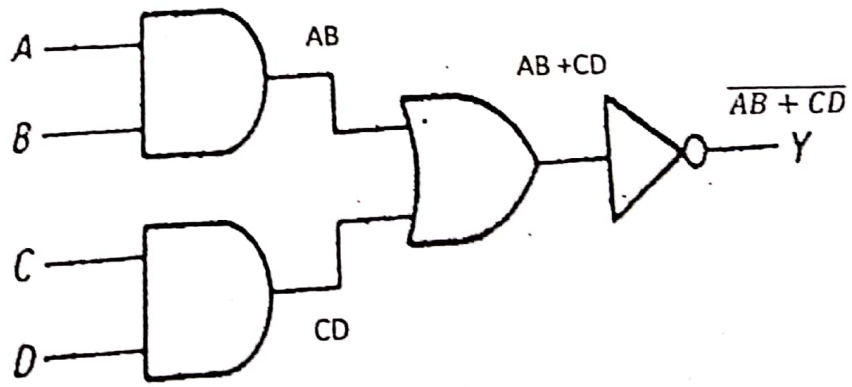
Equation $\boxed{\bar{A}.B + \bar{B}.A}$

It is XOR gate circuit

Truth Table

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

Pr.12 Write equation and make truth table of given circuit.



Solution:

Equation $\boxed{Y = \overline{AB + CD}}$

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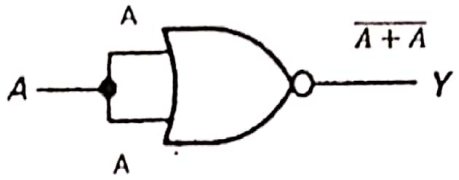
Truth Table

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

Pr.13 Write equation and make truth table of given circuit.



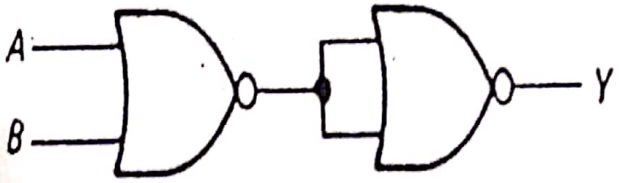
Solution:

Equation $\boxed{Y = \overline{A + A}}$

Truth Table

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

Pr.14 Write equation and make truth table of given circuit.



Solution:

Equation $\boxed{Y = A + B}$

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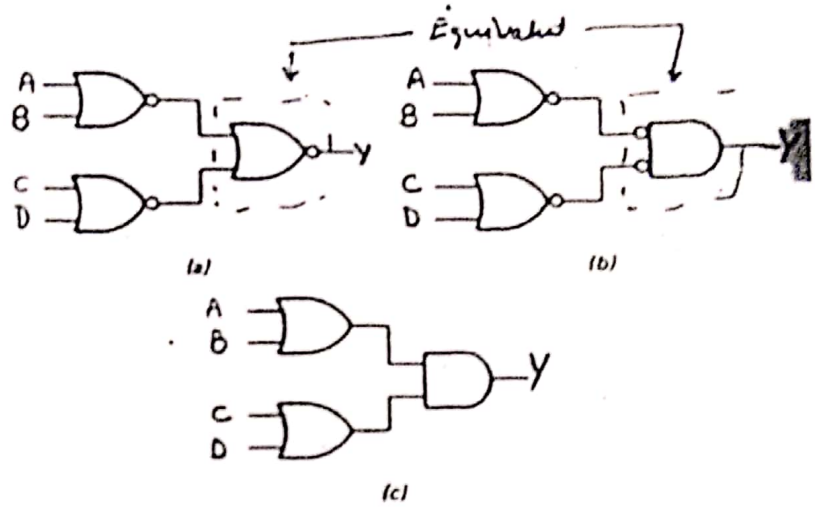
Truth Table

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

Pr.15 Write equation and make truth table of given circuit.



Solution:

Equation: $Y = (A + B)(C + D)$

There are $2^4 = 16$ words in Truth Table

Truth Table

A	B	C	D	Y = (A +B) (C +D)
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	1
0	1	1	0	1
0	1	1	1	1
1	0	0	0	0
1	0	0	1	1
1	0	1	0	1
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

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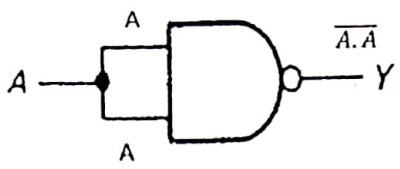
Pr.16 Write equation and make truth table of given circuit.



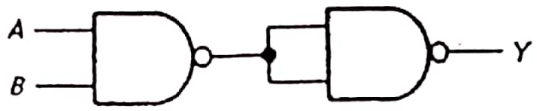
Solution:

Equation $Y = \overline{A.A}$

Truth Table

A	$Y = \overline{A.A}$
0	1
1	0

Pr.17 Write equation and make truth table of given circuit.



Solution

Equation $Y = AB$

Truth Table

A	B	Y = AB
0	0	0
0	1	0
1	0	0
1	1	1

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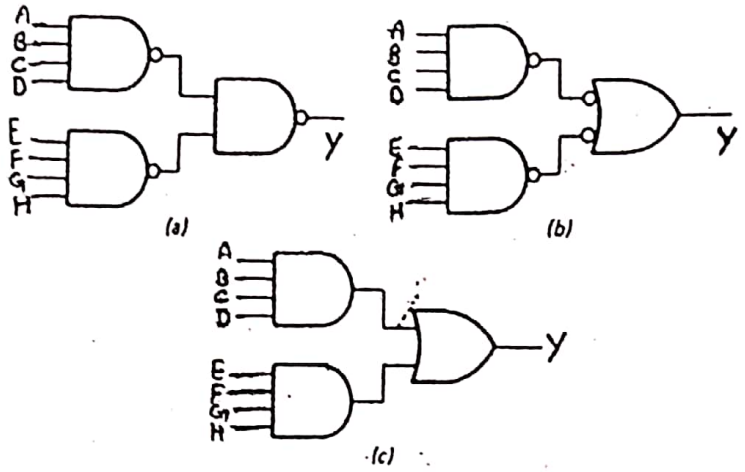
Pr.18 Write equation and make truth table of given circuit.



Solution

Equation | Y = (ABCD) + (EFGH) |

Truth Table has 2^8 = 256 words.

Important Board Questions

Q1. What is Integrated circuit?

Ans. Integrated circuit is that circuit in which the circuit components such as resistors, capacitors, diodes and transistors etc are automatically parts of a small semiconductor chip.

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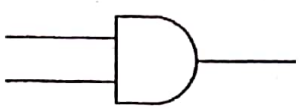
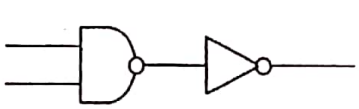
Q2. Make AND gate by using NOR gate.

Solution:

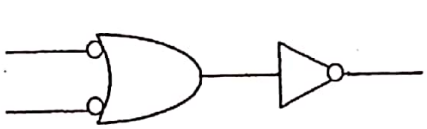
Step1



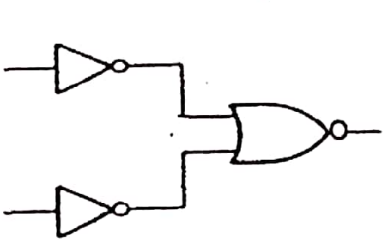
Step2



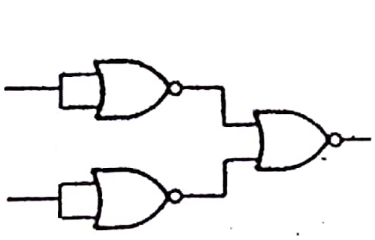
Step3



Step4



Step5



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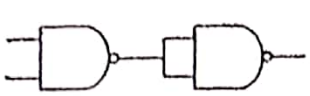
Q3. Make AND gate by using NAND gate.

Step1

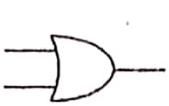
Step2

Step3

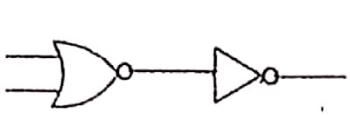


Q4. Make OR gate by using NAND gate

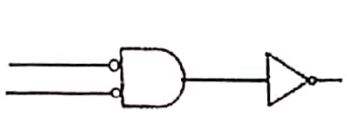
Step1



Step2

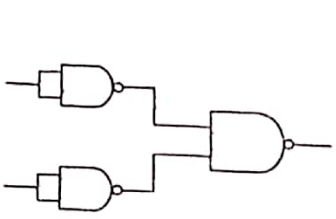


Step3



Step4

Step5



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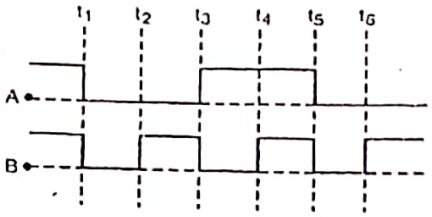
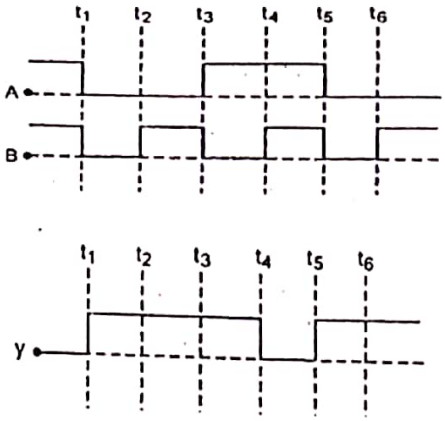
Q5. Sketch the output y from a NAND gate having inputs A and B given below.



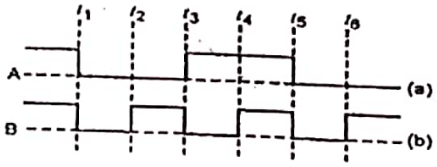
Sol. For NAND gate the Boolean expression is $y = \overline{A.B}$

For the given wave form, we have the following values for A, B and y.

A	B	Y
1	1	0
0	0	1
0	1	1
1	0	1
1	1	0
0	0	1
0	1	1



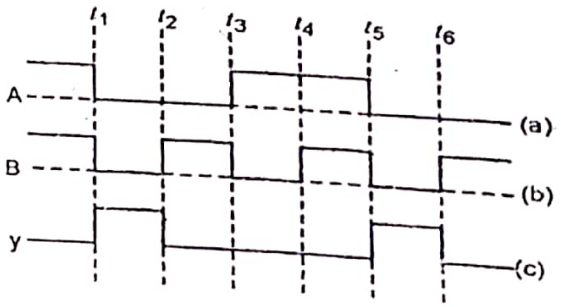
Q6. Sketch the output y from a NOR gate having inputs A and B as given in Fig.



Sol. For NOR gate the Boolean expression is $y = \overline{A + B}$

For the given wave form, we have the following values for A, B and y.

A	B	Y
1	1	0
0	0	1
0	1	0
1	0	0
1	1	0
0	0	1
0	1	0



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