→ Circuits

↳ Boolean Algebra is used to model the circuitry of electronic devices. Each input and output of such a device can be thought of as a member of the set {0, 1}

1 → ON/HIGH

0 → OFF/LOW

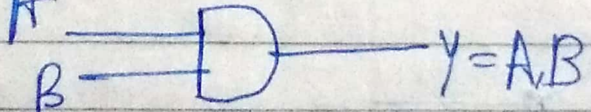
The basic elements of circuits are called logic gates.

→ Logic Gates

① AND Gate

(Boolean Product)

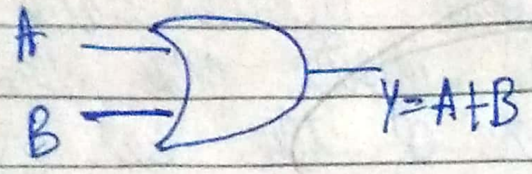
↳ It performs 'and' operation it has 2 n inputs and 1 output



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

(2) OR GATE (Boolean sum)

↳ It performs OR operation. It has n-inputs & 1 output

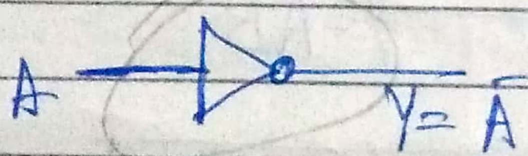


A	B	Y=A+B
0	0	0
0	1	1
1	0	1
1	1	1

(3) NOT GATE (Complement)

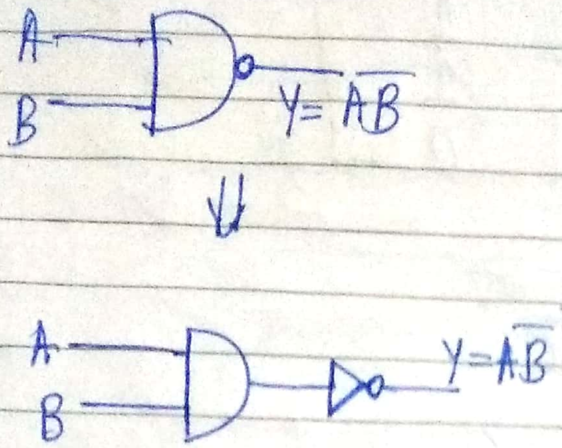
(Inverter)

↳ 1 input & 1 output



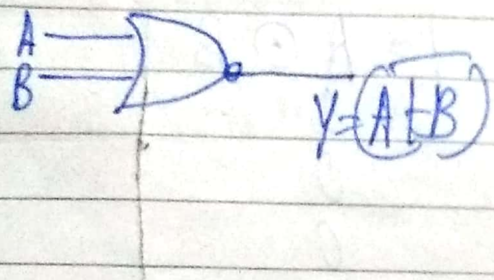
A	$Y = \bar{A}$
0	1
1	0

(4) NAND GATE (Boolean product complement)

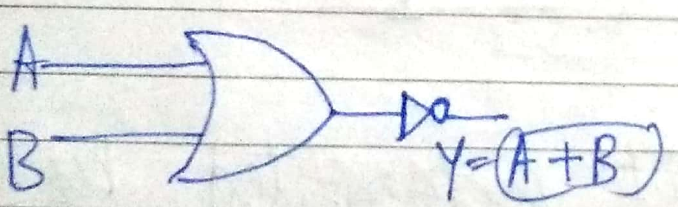


A	B	$Y = \overline{AB}$
0	0	1
0	1	1
1	0	1
1	1	0

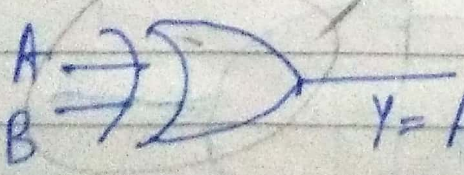
(5) NOR GATE (Boolean Sum complement)



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



(6) ~~B~~ Ex-OR Gate / XOR Gate
(Exclusive OR)



(In sets)

$Y = A \oplus B \;(\equiv A \cup B - A \cap B \equiv A - B)$

$$A \oplus B = \overline{A}B + A\overline{B} \text{ or } (A+B)(\overline{A}+\overline{B})$$

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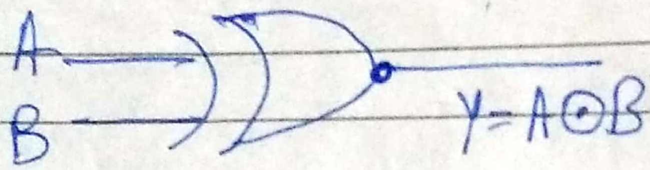
A	B	$A \oplus B$
0	0	0
0	1	1
1	0	1
1	1	0

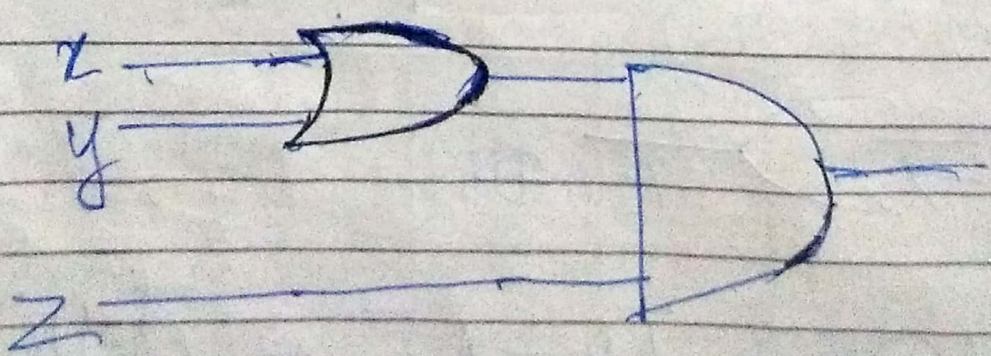
7. EX-NOR Gate



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

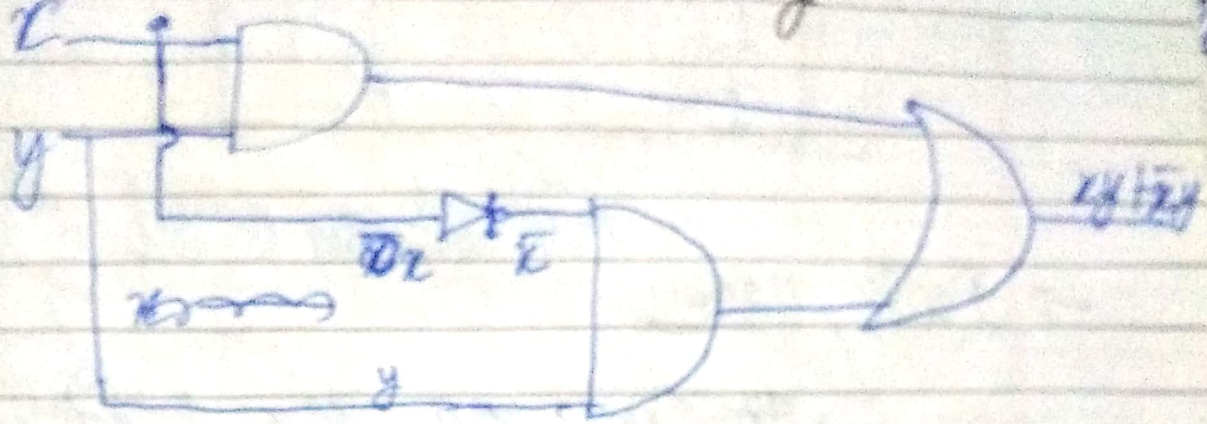
Q. Draw the circuit represented by the boolean function

$$f(x, y, z) = (x + y)z$$



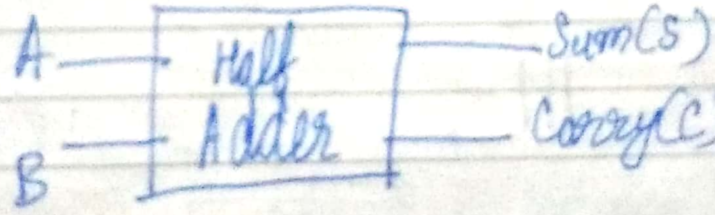
Q. $f(x, y, z) = xy + \bar{x}y = (x + \bar{x})y$

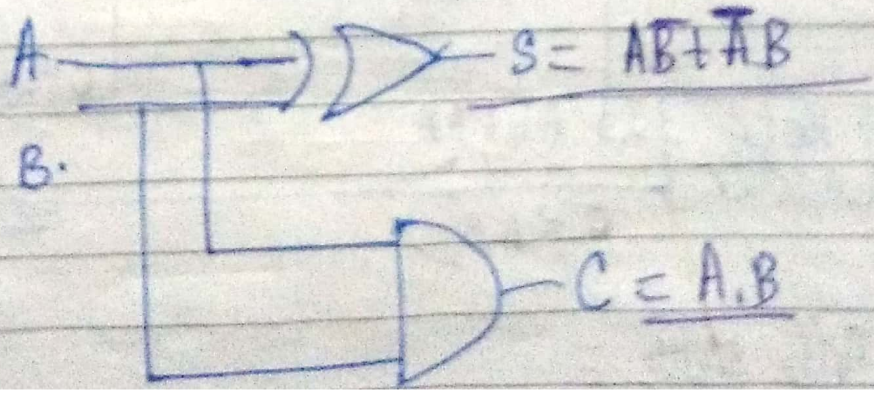
$= 1 \cdot y$



→ Half adder

↳ It is a combinational logic circuit with 2 inputs & 2 outputs. It is designed to add 2 single bit binary numbers.

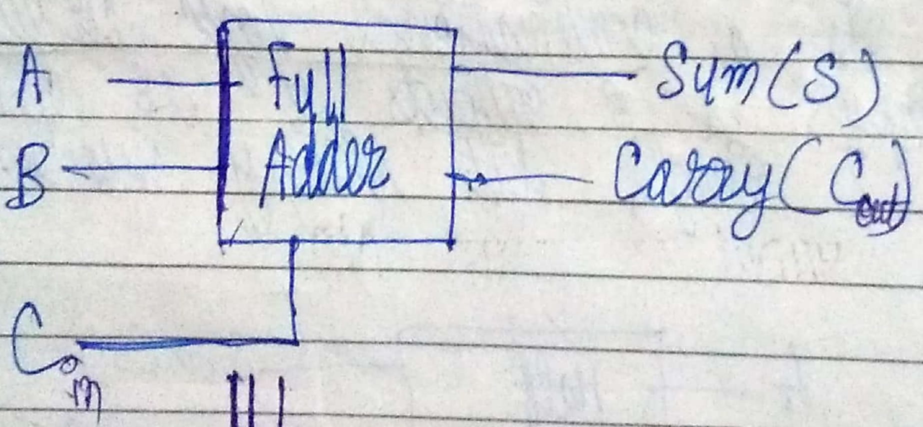




A	B	(+) S	(.) C
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

→ **Full adder** → Will add carry as well

→ It can add two 1 bit numbers & carry. therefore, full adder is 3 input & two outputs. device.



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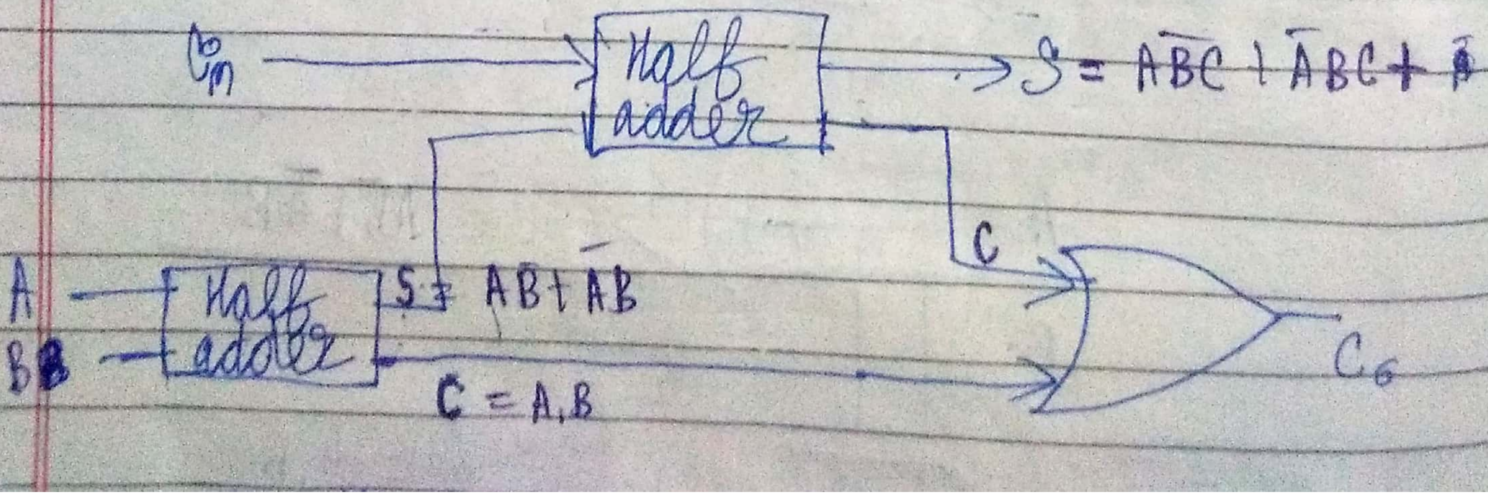


A	B	C_{in}	S(A+B)	C_o
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

$$\boxed{C_o = \bar{A}BC_{in} + A\bar{B}C_{in} + AB\bar{C}_{in} + ABC_{in}}$$

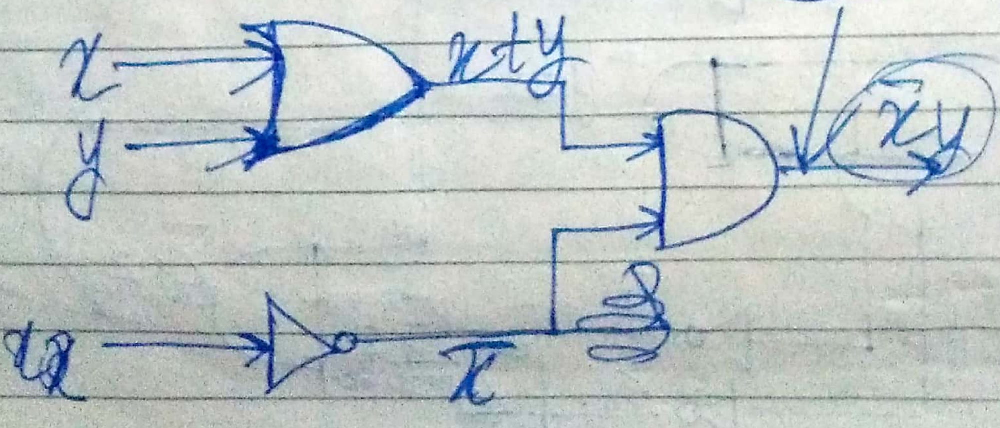
$$\boxed{S = \bar{A}\bar{B}C_{in} + \bar{A}B\bar{C}_{in} + A\bar{B}\bar{C}_{in} + ABC_{in}}$$

Q. Find the output of given ckt.

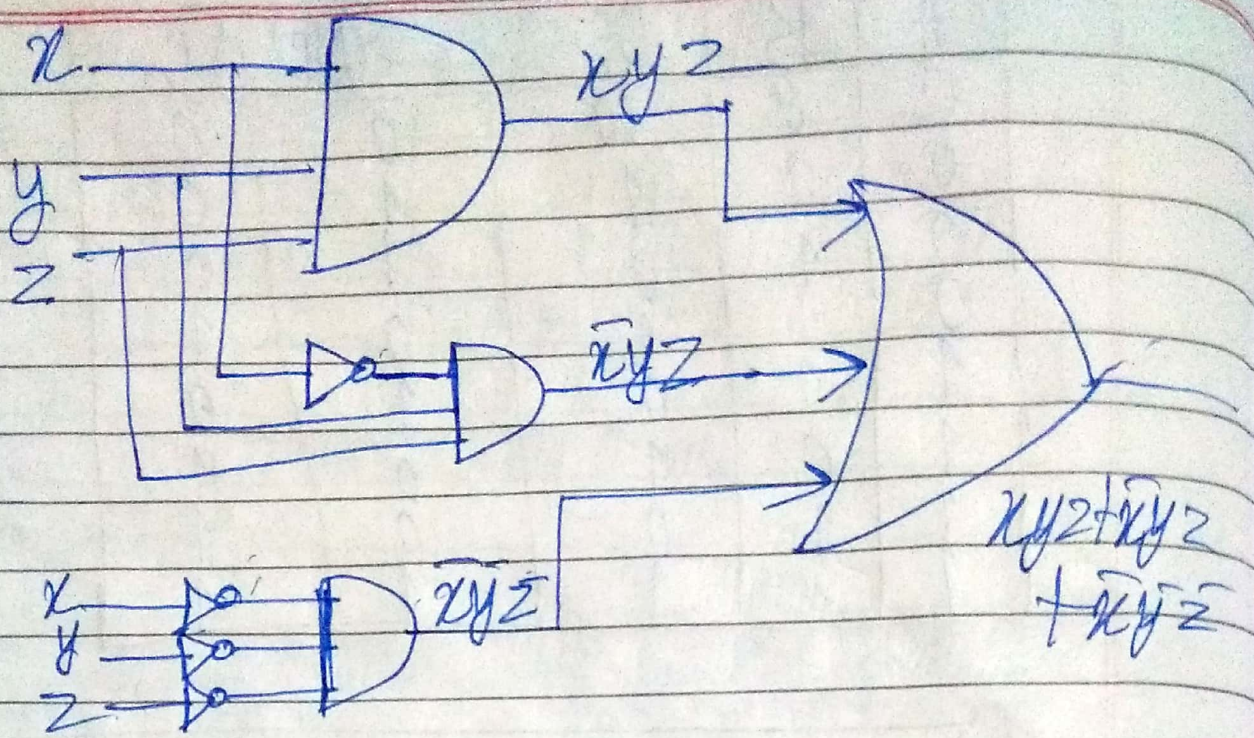
$(x+y).\bar{x} = x\bar{x} + \bar{x}y$

$= 0 + \bar{x}y$

i)



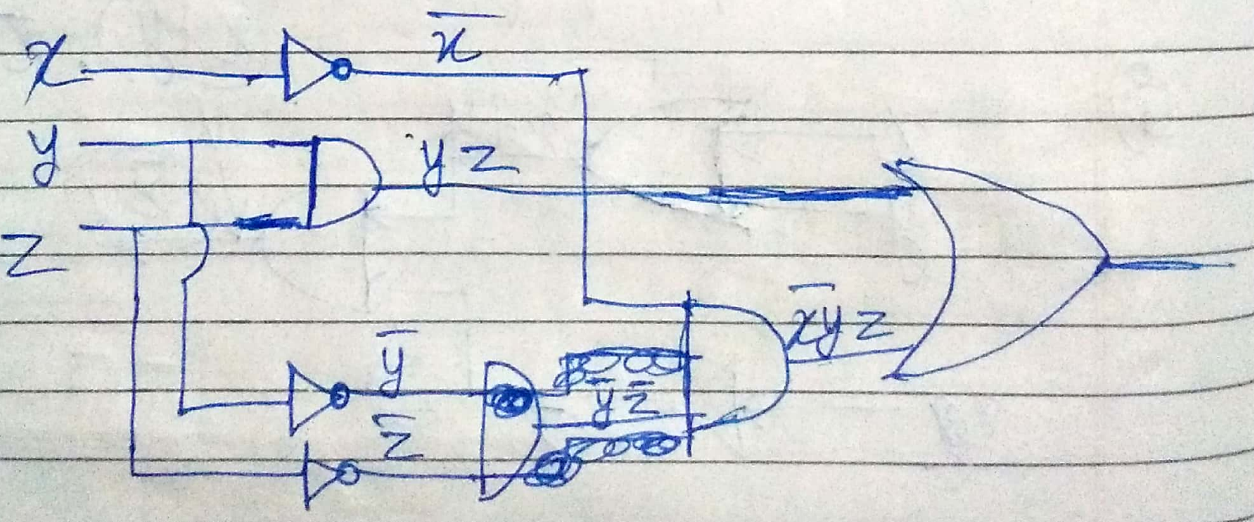
ii)



$$xyz+\bar{x}yz+\bar{x}\bar{y}\bar{z} = \boxed{yz+\bar{x}\bar{y}\bar{z}}$$

↳ Minimized circuit

→ Minimization of Circuit



The goal is to produce boolean sums of ~~b~~ boolean products that represents a boolean expression with fewest product of literals such that those products contain the fewest literals possible among all S.O.Ps that represent a boolean function. Finding such a S.O.P is called minimization of boolean function. Minimizing a boolean function. → (D.N.F)

Ex.