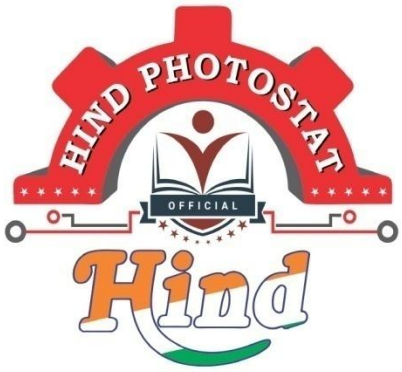

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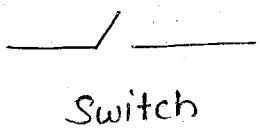
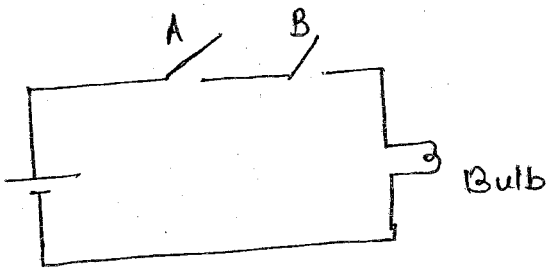
BOOLEAN ALGEBRA

Logic gates

AND gate:-



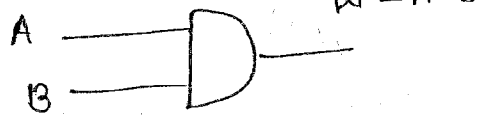
Switch



Bulb glows when both switches are ON.

Truth table:-

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



Hence from ckt it is clear that when switches are connected in series then results as AND gate

AND gate also called as series switch.

Set the ones**

$X = \{2, 3, 5\}$

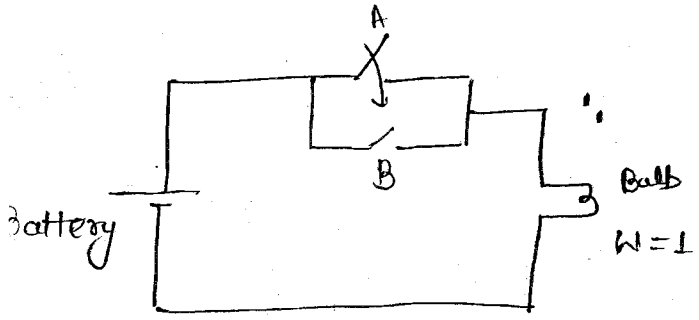
$Y = \{3, 6, 7\}$

$(X \cap Y) = \{3\}$

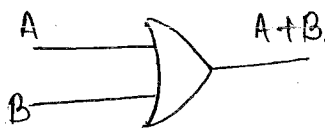
intersection

In set theory AND gate is called as intersection

OR gates



Switches are in Parallel.

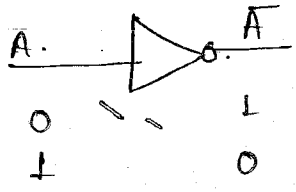


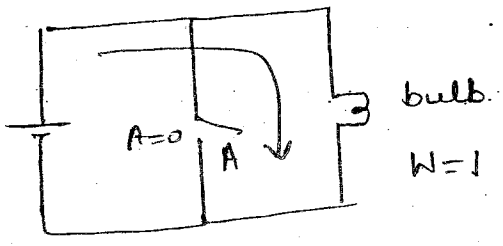
Truth table

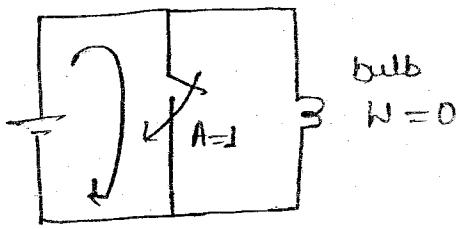
A	B	W
0	0	0
0	1	1
1	0	1
1	1	1

* In set theory OR gate is represented as union.

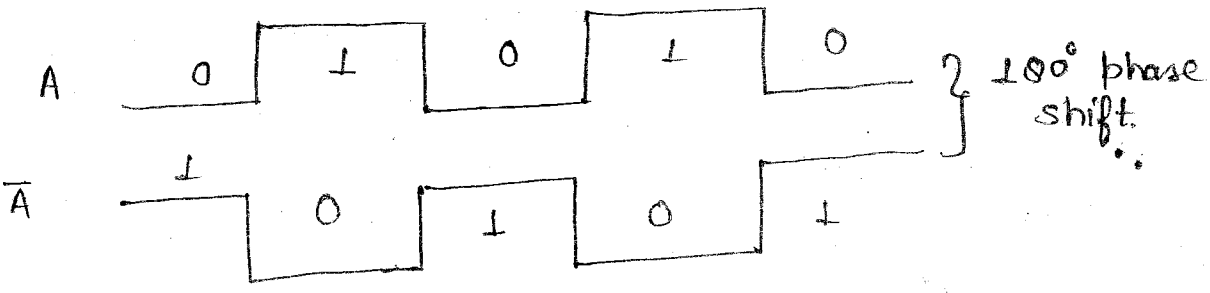
NOT gates







Current follows low resistance path



AND, OR, NOT gates are called basic gates

Precedence of operators

( ) > NOT > AND > OR

For example –

$Y = 2*x + 3$

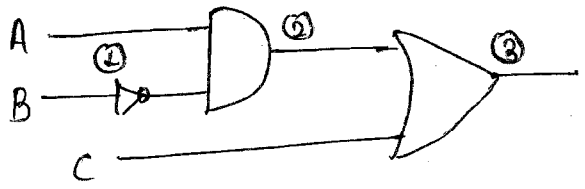
(i) $2(x+3)$

(ii) $Y = (2*x) + 3$ (✓)

To get $Y = 2*x + 3$ first multiplication has to be done & followed by addition hence option (ii) is correct.

So Multiplication has higher precedence.

Eg. To realize $f = A \cdot \bar{B} + C$.



Precedence order is NOT, AND, OR.

OR gate properties

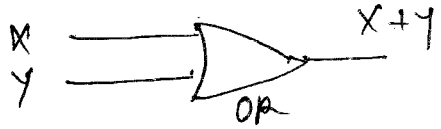
1. $A + 0 = A$
2. $A + 1 = 1$
3. $A + A = A$
4. $A + \bar{A} = 1$

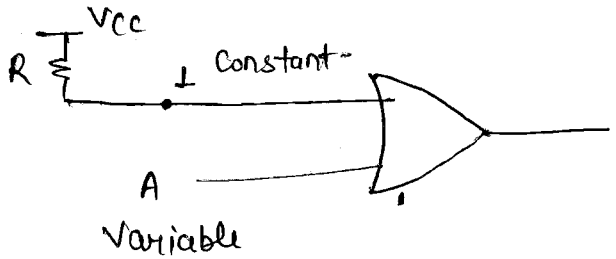
AND gate properties

1. $A \cdot 0 = 0$
2. $A \cdot 1 = A$
3. $A \cdot A = A$
4. $A \cdot \bar{A} = 0$.

Proof of OR gate property (2)

$A + 1 = 1$





when $A = 0$. $\quad O/P = 1 + 0 = 1$

when $A = 1$ $\quad O/P = 1 + 1 = 1$.

Hence. for any value of A

$$\boxed{Y = A + 1 = 1}$$ Prooved.

Distributive Properties

(i) $A.(B+C) = A.B + A.C$.

(ii) $(A+B).(A+C) = A + BC$

L.H.S $= (A+B).(A+C)$

$= A.A + A.C + B.A + B.C$

$= A + AC + AB + B.C$

$= A(1 + C + B) + BC$ → using OR gate IInd property $A+1 = A$.

$= A + BC = R.H.S$ Prooved.

Q Proove

$X + \bar{X}Y = X + Y$.

L.H.S $= X + \bar{X}Y \quad = (X+\bar{X}).(X+Y)$

~~$= X(Y+\bar{Y}) + \bar{X}Y \quad = X(Y+\bar{Y})$~~ $= 1.(X+Y)$

~~$= XY + X\bar{Y} + \bar{X}Y$~~ $= X + Y$.

Prooved

Question—

$\bar{X} + XY = ?$ (Take first element in second term's complement).

$\bar{X} + XY = \bar{X} + Y$

Question.- $DB + \bar{B}CD$

$D(B + \bar{B}C)$

$D(\bar{\bar{B}} + C)$.

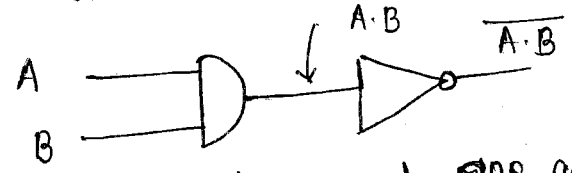
De Morgan's Law :-

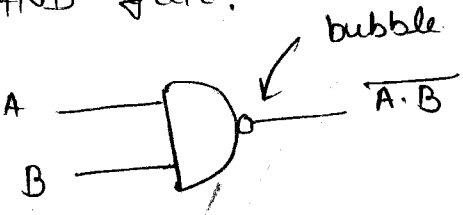
$\overline{A+B} = \bar{A} \cdot \bar{B}$

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

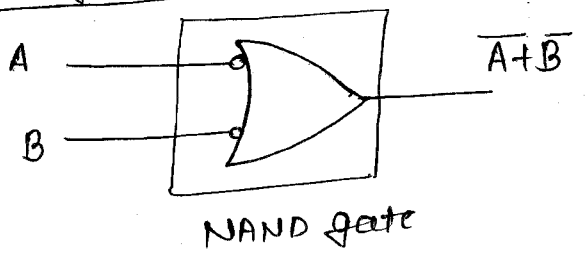
NAND gate :—

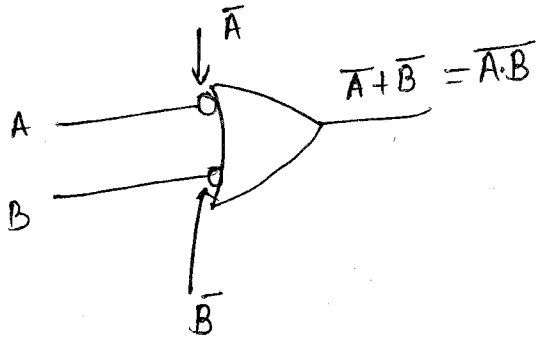
NAND gate means NOT of AND gate.





NAND gate in terms of OR gate



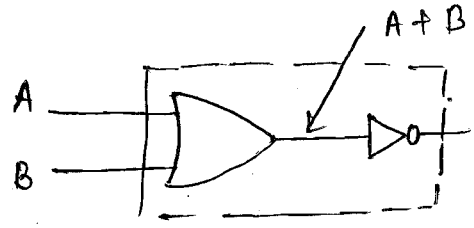


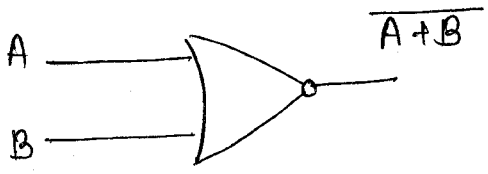
Truth table

A	B	A·B	$\overline{A \cdot B}$
0	0	0	1
0	1	0	1
1	0	0	1
1	1	1	0

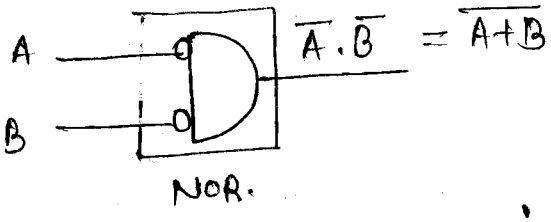
NOR gate

NOT of OR gate.





NOR gate in terms of AND gate :-



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

* NAND gate & NOR gate are called Universal gates.

UNIVERSAL GATE's

* Universal means functionally complete.

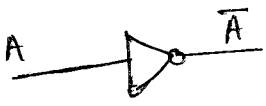
Any boolean logic can be realized using universal gates.

Ex- µP can be constructed using only NAND gates.

IES - 4 Marks Proove NAND is universal.

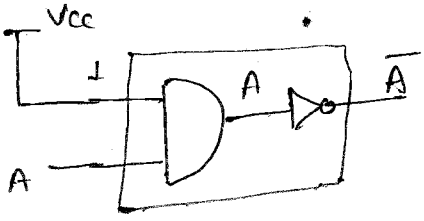
TEST:- Realize basic gates {AND, OR, NOT}

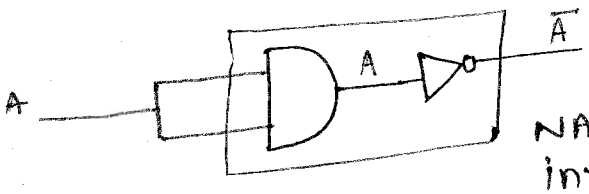
NOT gate



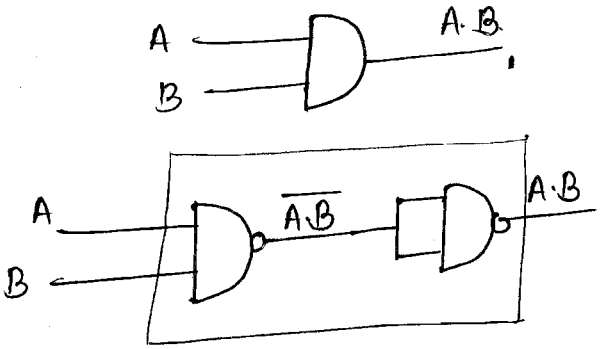
$\because$ $A.A = A$

$A.1 = A$

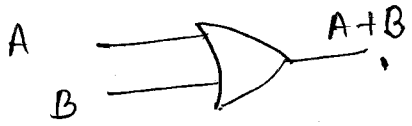




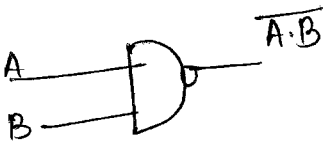
AND gate from NAND gate



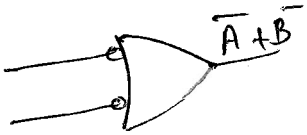
OR gate from NAND gate:-

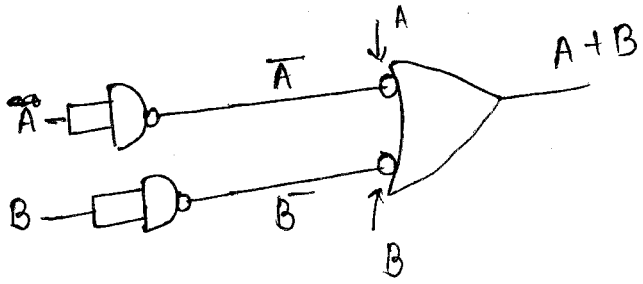


NAND gate



or





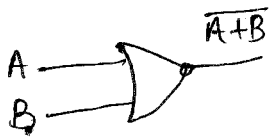
Proove NOR gate as universal gate?

Test - (OR, AND, NOT gate from NOR gate)

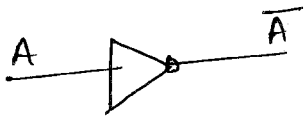
Property
A+0 = A
A+A = A.

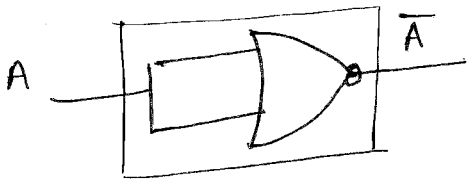
(1) NOT gate from NOR gate

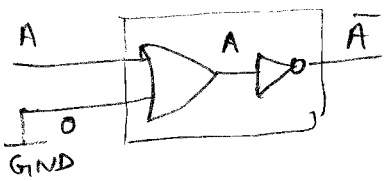
NOR gate

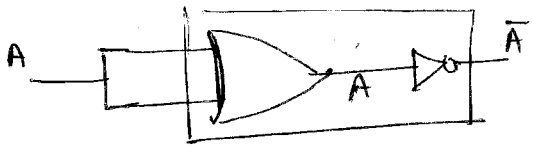


NOT gate



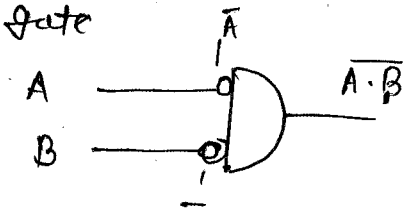


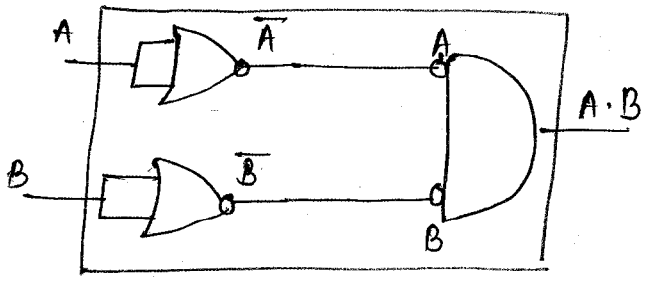




AND gate from NOR gate :-

NOR gate

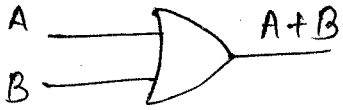




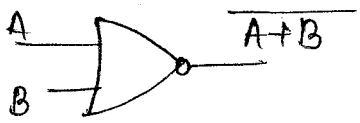
AND gate

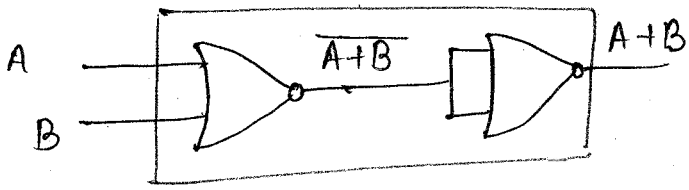
OR gate from NOR gate :-

OR gate



NOR gate





OR gate

Question- Gate EC - 2015 2Marks / IAS

Proove $\bar{A}+B$ is universal assume Vcc and ground are available.