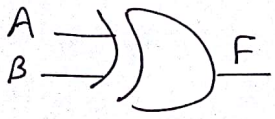
Logic Diagrams:

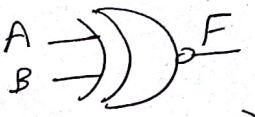
XOR



$F = A \oplus B$

$= A'B + AB'$

XNOR



$F = (A \oplus B)'$

$= A'B' + AB$

Ex.: Draw the logic diagram of "F" in AND, OR, inverter

$F = (a \oplus b)(c \oplus d)'$

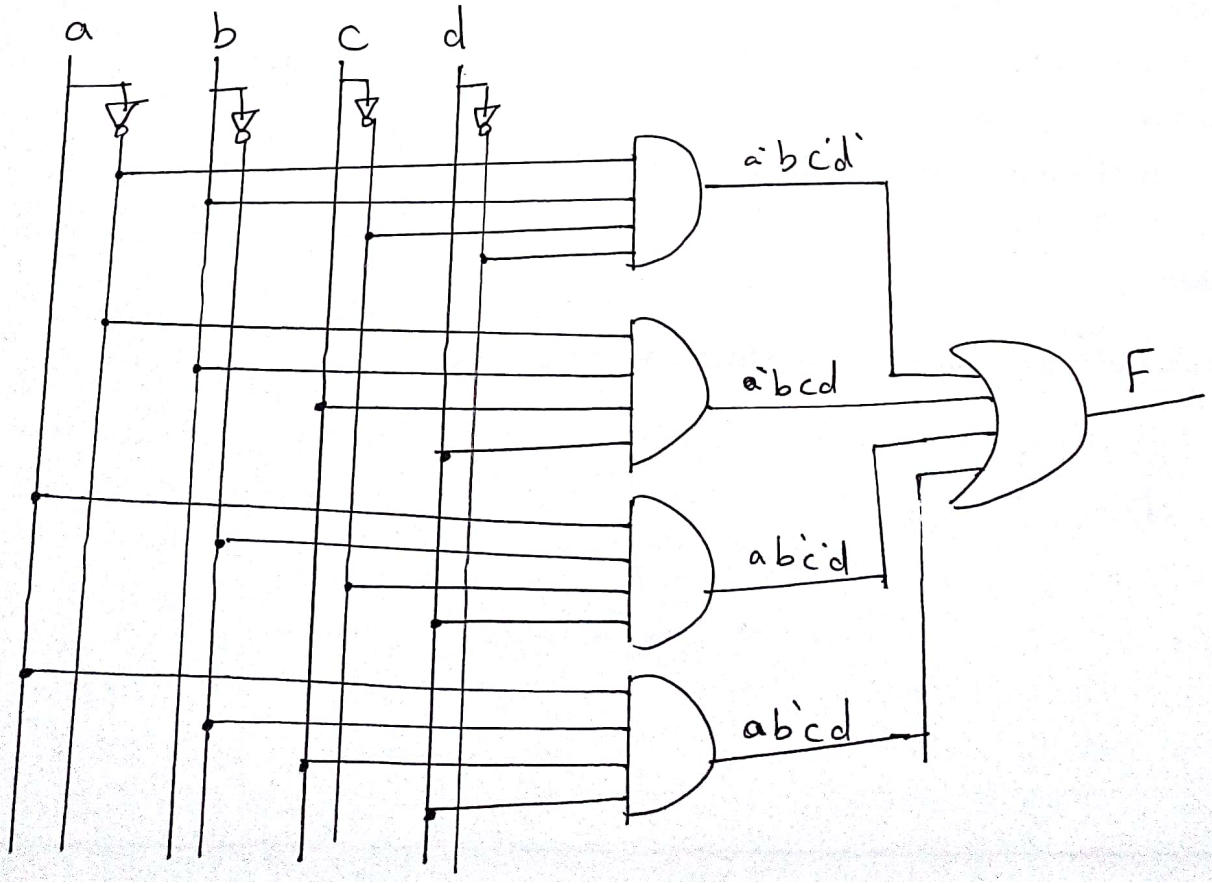
ANS.

$F = (a \oplus b)(c \oplus d)'$

$= (a'b + ab')(c'd' + cd)$

$= a'bc'd' + a'bcd + ab'c'd' + ab'cd$

Then Draw it using AND, OR, inverter (NOT)



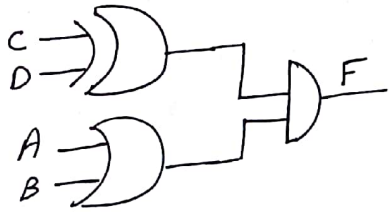
Q3-3o P.118

* Implement the following Boolean expression with exclusive-OR (XOR) and AND gates:

$$F = A\bar{B}C\bar{D} + \bar{A}BC\bar{D} + A\bar{B}\bar{C}D + \bar{A}B\bar{C}D$$

Ans.

$$F = A\bar{B}(C\bar{D} + \bar{C}D) + \bar{A}B(C\bar{D} + \bar{C}D)$$
$$= (C\bar{D} + \bar{C}D)(A\bar{B} + \bar{A}B)$$
$$= (C \oplus D)(A \oplus B)$$



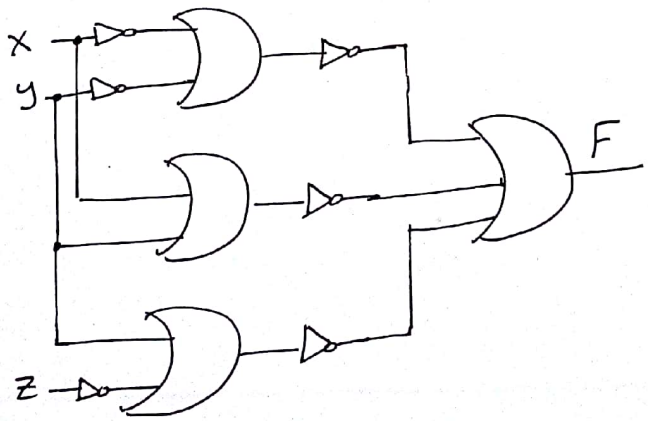
Ex. * Using "only" OR and NOT gates: draw a schematic for this function:

$$F = xy + \bar{x}\bar{y} + \bar{y}z$$

≤ You must manipulate the function to draw it using OR, NOT gates only.
- That by complementing the function twice:

Ans.

$$(F)' = [(xy + \bar{x}\bar{y} + \bar{y}z)']'$$
$$= [(xy)'(\bar{x}\bar{y})'(\bar{y}z)']'$$
$$= [(\bar{x}+\bar{y})(x+y)(y+\bar{z})]'$$
$$= (\bar{x}+\bar{y})' + (x+y)' + (y+\bar{z})'$$



Ex.

* $F = ab'c + ad + bd$

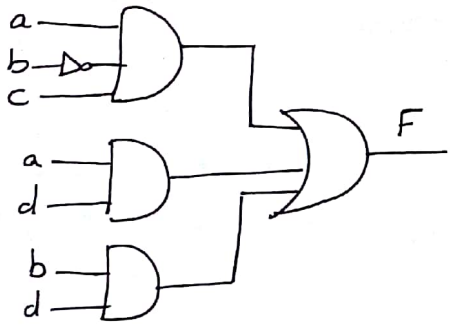
a) show a block diagram by using AND, OR, gates.

b) show a block diagram by using 2 inputs AND, OR gates

ANS.

a) using AND, OR gates.

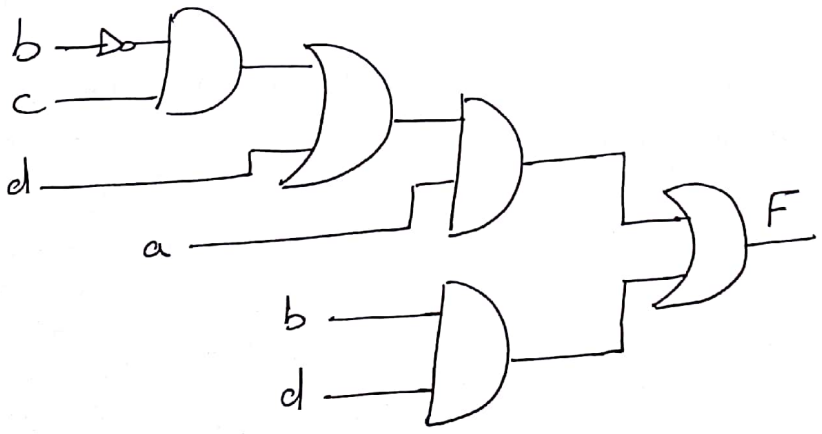
$F = ab'c + ad + bd$



b) using 2 inputs AND, OR gates.

$F = ab'c + ad + bd$

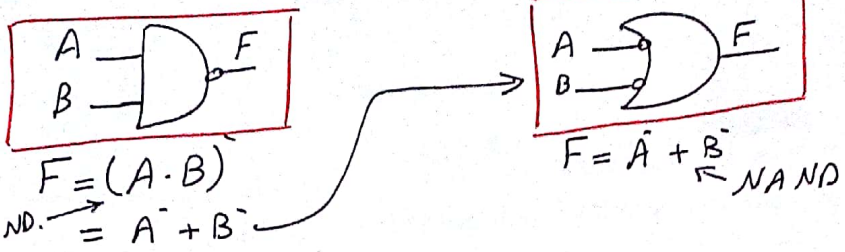
$= a(b'c + d) + bd$



NAND , NOR implementation:

NAND

⇒ There two graphic symbols for the "NAND" gates.



$F = (A \cdot B)$

NAND. $= \bar{A} + \bar{B}$

$F = \bar{A} + \bar{B}$ ← NAND

+ Two level NAND:

→ "SoP" Form

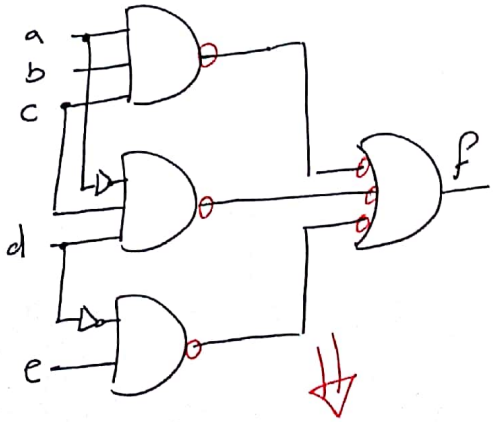
Ex. $f = abc + \bar{a}cd + d\bar{e}$

① نرسم بـ OR , AND

② نحول كل AND أو OR لـ NAND.

③ ونغير كل not بحيث يكون لدي عكسي (not)

في حالة الـ (SoP) f نحتاج تغير الـ not بـ not لأنه هيكون منطقة



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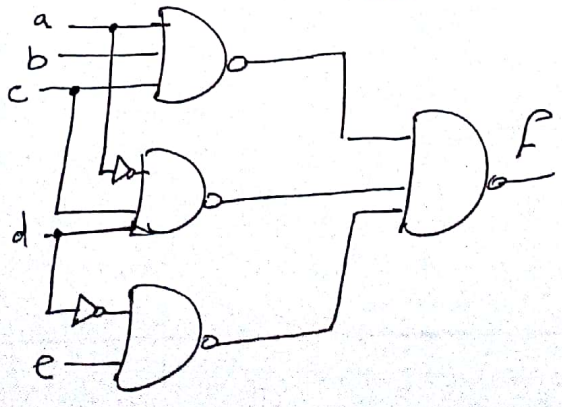


* Multi level NAND

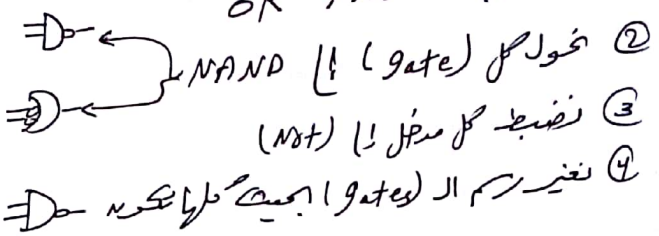
(sop) تكون المعادلة ان (Multi level NAND) الـ يشترط

Ex.

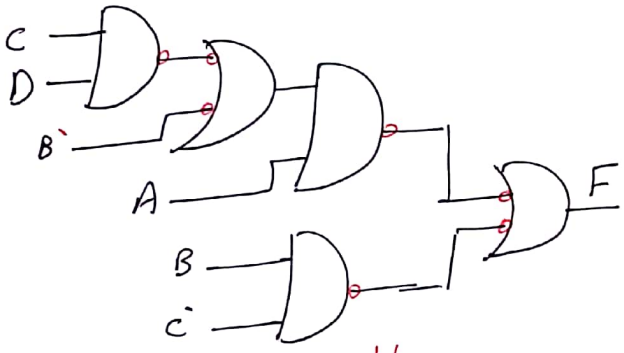
- Draw the multi level NAND circuit for the following expressions:

a) $F = A(CD + B) + B\bar{C}$

⇒ Assuming all variables are available (complemented and uncomplemented)



ANS-



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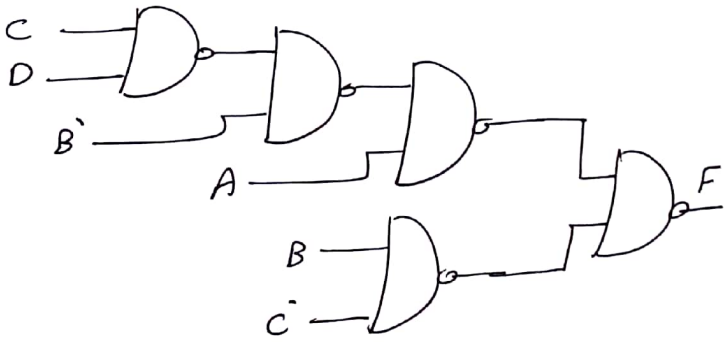


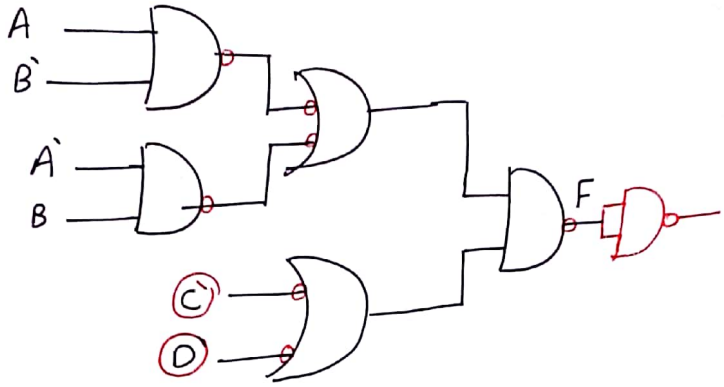
Ex.

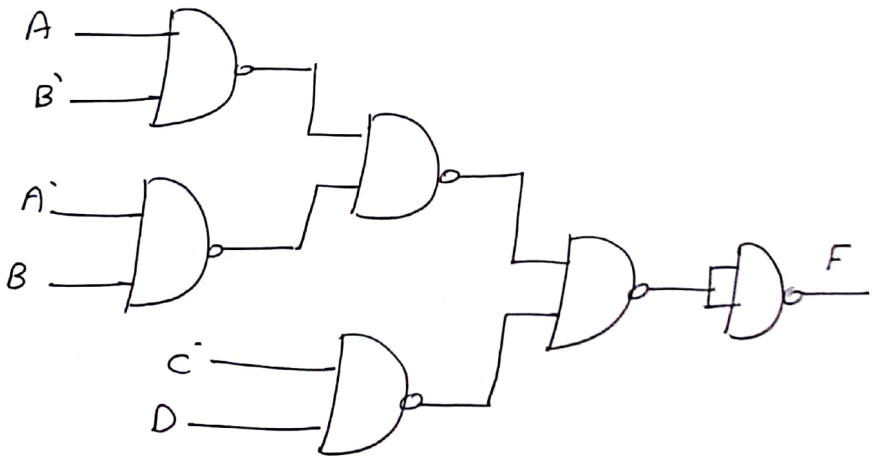
→ Draw the Multilevel NAND circuit for the following expressions:

$$F = (A\bar{B} + \bar{A}B)(C+D')$$

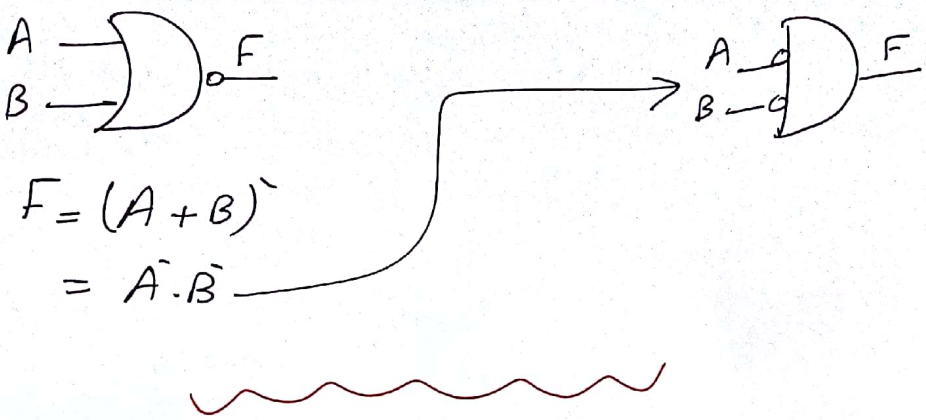
→ Assuming All variables are vilable:

Ans.





NOR gates.

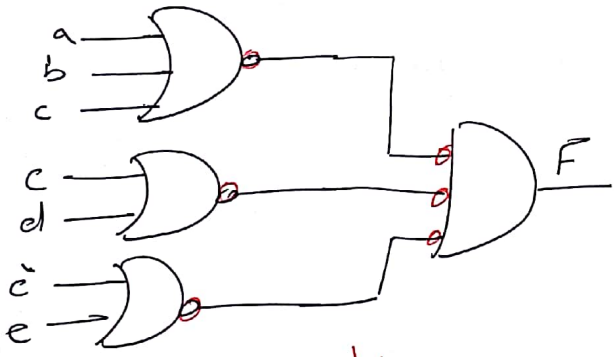


$F = (A + B)'$

$= A'.B'$

* **two level NOR**
  ↳ "POS" form.

Ex. $F = (a+b+c)(c+d)(\bar{c}+e)$



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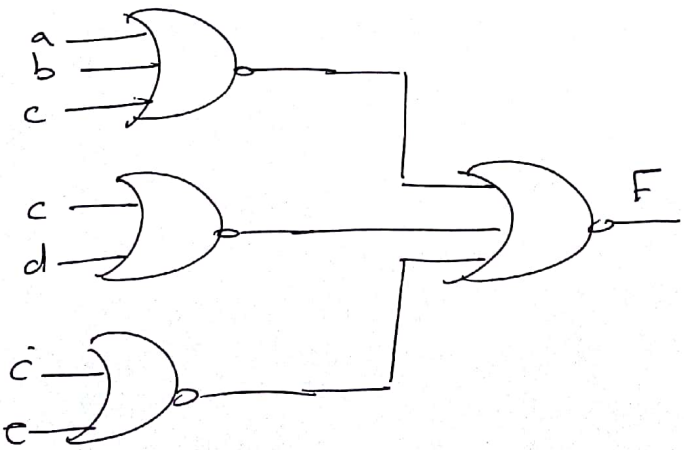
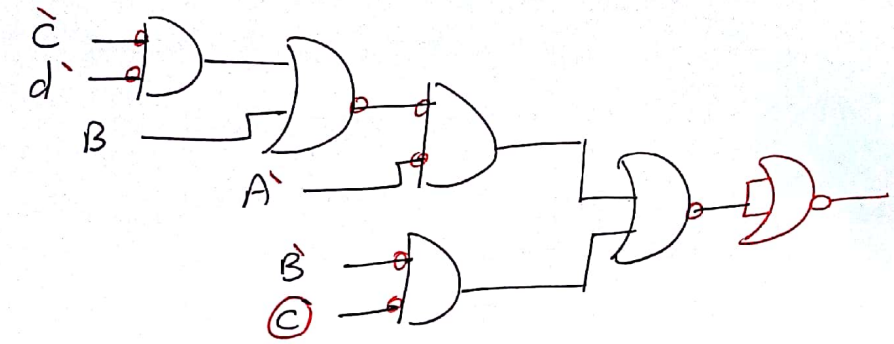


* Multilevel NOR.

* لازم يشترط انها تكون المعادلة (Pos)

Ex. $F = A(CD+B) + B\bar{C}$



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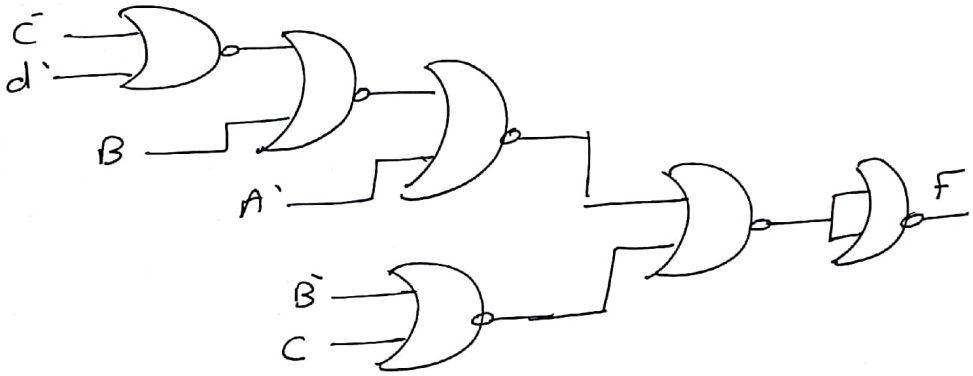


*Examples on two level NOR

↳ Simplify the following Functions & implement them with Two-level NOR gate circuits::

a) $F = wx' + y'z' + w'yz'$

b) $F(w, x, y, z) = \Sigma(1, 2, 13, 14)$

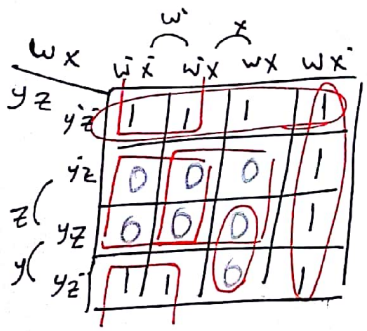
c) $F(x, y, z) = [(x + y)(x' + z)]'$

d) $F(A, B, C, D) = \Sigma(2, 4, 6, 10, 12)$
$d(A, B, C, D) = \Sigma(0, 8, 9, 13)$

(Two-level NOR) ← للرسم بـ
لابد من الحصول ع
"Pos form" ع
(K.map) ← ع

ANS.

a) $F = wx' + y'z' + w'yz'$

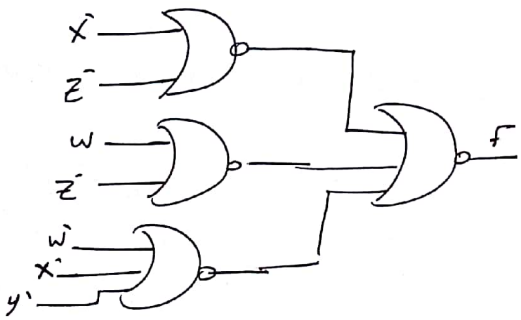


From Zero's

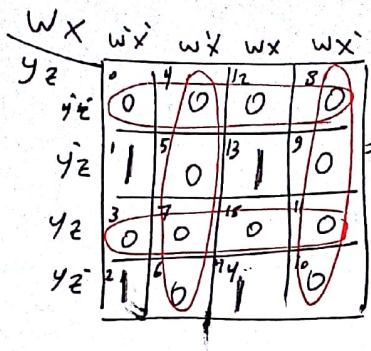
↳ $F' = xz + w'z + wxy$

↳ $F = (x' + z')(w + z')(w'x + y')$

then Draw it.



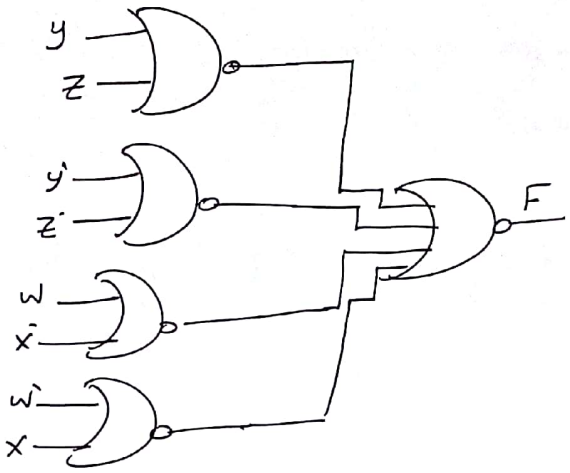
b) $F(w,x,y,z) = \Sigma(1,2,13,14)$



$\bar{F} = y\bar{z} + yz + \bar{w}x + w\bar{x}$

$F = (y+z)(\bar{y}+\bar{z})(w+\bar{x})(\bar{w}+x)$

Then draw it.

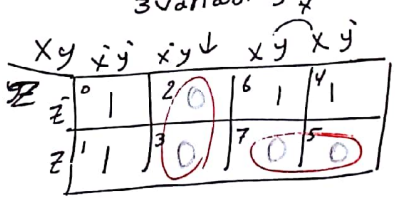


c) $f(x,y,z) = \overline{[(x+y)(\bar{x}+z)]}$

$= \overline{(x+y)} + \overline{(\bar{x}+z)}$

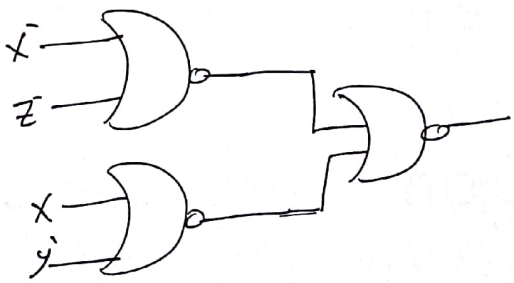
$= \bar{x}\bar{y} + x\bar{z}$

3 variables x



$\bar{f} = xz + \bar{x}y$

$f = (\bar{x}+\bar{z})(x+\bar{y})$



d) $F(A,B,C,D) = \Sigma(2,4,6,10,12)$

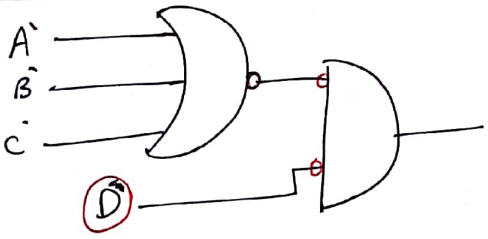
$d(A,B,C,D) = \Sigma(0,8,9,13)$

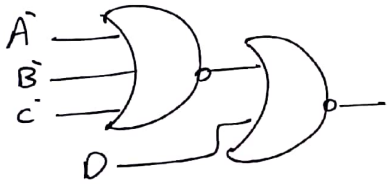
ANS.

AB / CD	$\bar{A}\bar{B}$	$\bar{A}B$	AB	$A\bar{B}$
$\bar{C}\bar{D}$	0: X	4: 1	12: 1	8: X
$\bar{C}D$	1: 0	5: 0	13: X	9: X
CD	3: 0	7: 0	15: 0	11: 0
$C\bar{D}$	2: 1	6: 1	14: 0	10: 1

$\Rightarrow \bar{f} = D + ABC$

$f = \bar{D}(\bar{A} + \bar{B} + \bar{C})$





Ex: (Assume All inputs are available), show two level implementation of:

$$f = wx + wz + \bar{w}\bar{x} + w\bar{y}\bar{z}$$
$$= (\bar{w} + x + z)(w + \bar{x} + y)(w + \bar{x} + \bar{z})$$

a) by using NAND.

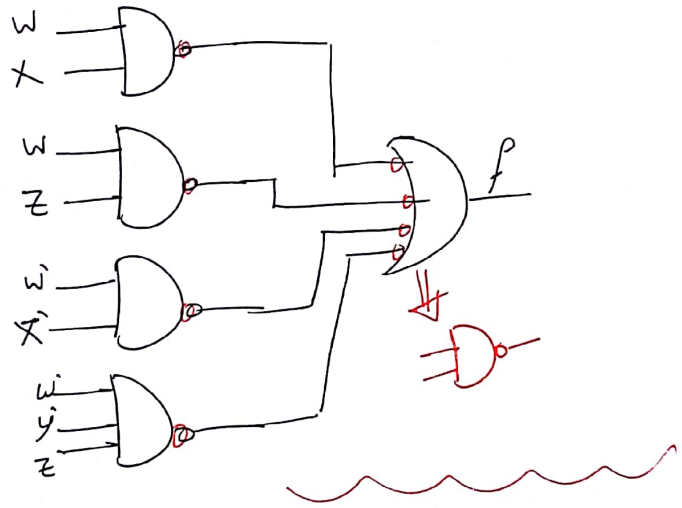
b) by using NOR.

c) by using 2inputs NAND.

Ans.

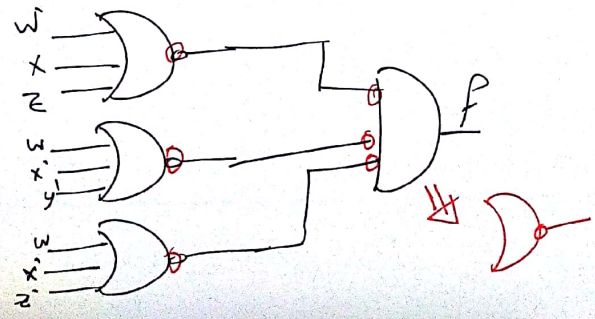
a) by using NAND: ⇒ two level NAND.
⇒ we will use "Sop" form

$$f = wx + wz + \bar{w}\bar{x} + w\bar{y}\bar{z}$$



b) by using NOR: ⇒ two level NOR:
⇒ we will use "Pos" form.

$$f = (\bar{w} + x + z)(w + \bar{x} + \bar{y})(w + \bar{x} + \bar{z})$$



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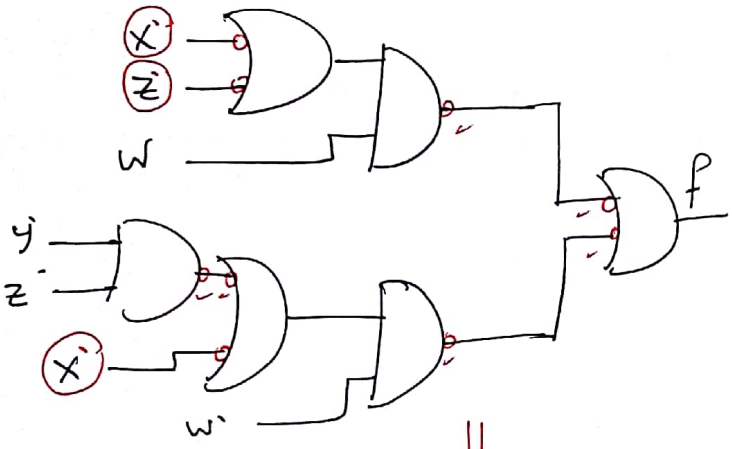
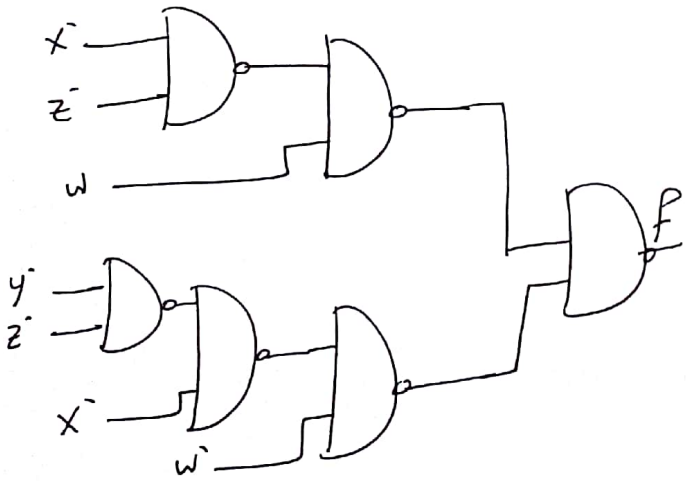
c) To use 2 inputs NAND, we must manipulate the function. "f" → to be 2 inputs for each gate.

$$f = wx + wz + \bar{w}x + \bar{w}\bar{y}\bar{z}$$

$$= w(x + z) + \bar{w}(x + \bar{y}\bar{z})$$





AND_OR - inverter

$F = (AB + CD + EF)'$

(SoP)'

AND - OR - inverter

≡

AND - NOR

$F = (AB + CD + EF)'$

$= (AB)'(CD)'(EF)'$

NAND - AND

كيف يمكن الحصول على ($\bar{F}$) في الـ "SoP"؟

$\bar{F} = AB + CD + EF$

من الشيء نعمل على الـ K.map لنستطيع الحصول على هذا الشكل

من المعادلة ونرسمه بأي طريقة من هذه الطرق

- AND - OR - inverter
- AND - NOR.
- NAND - AND.

$\bar{F} = AB + CD + EF$

$\bar{F}$ in SoP.

OR - AND - inverter

$$F = [(A+B)(C+D)(E+F)]'$$

(Pos)'

$F' = (A+B)(C+D)(E+F)$ ← F' in Pos.

OR - AND - inverter

OR - NAND.

$F = (A+B)' + (C+D)' + (E+F)'$

NOR - OR

كيف نحصل على (F) في "Pos"

حالة ① ⇐ لو المعادلة المعطاة على شكل (SOP) ← نأتي بال (F') لطرفين

حالة ② ⇐ لو المعادلة المعطاة على شكل (Pos) مثل: $F = (A+B)(C+D)(E+F)$

أو على شكل $F = \Pi(0,2,3\ldots)$

أو على شكل $F = \leq(1,4,5\ldots)$

الحل

① نضع المعادلة على K-map

② نستنبط الجوامد للحصول على (F) في شكل SOP.

③ ثم نأتي بال (F') لطرفين للحصول على (F') في شكل Pos

④ ثم نرسم بأحد الطريقتين التاليتين:

OR - AND - inverter

OR - NAND.

NOR - OR.

Q 3.24 P.118

*Implement the following Boolean function F. using the two level forms of logic:

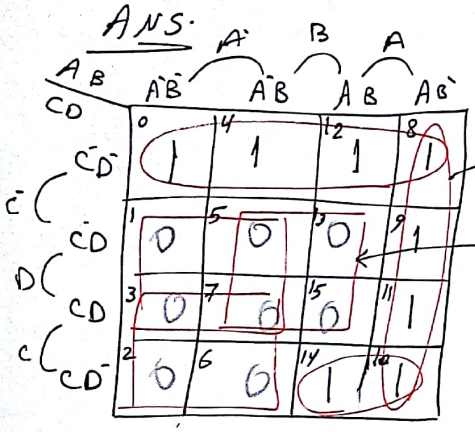
$$F(A,B,C,D) = \Sigma(0,4,8,9,10,11,12,14)$$

a) using NAND - AND.
b) using AND - NOR
c) OR - NAND
d) NOR - OR

a), b) → From → $\bar{f}$ in SOP → from (Zero's) on K.map.

c), d) → from → f in "SOP" → from (1's) on K.map.
Then → use Demorgan for $\bar{f}$.

ANS:



$*f = C\bar{D} + A\bar{B} + AC\bar{D}$

$*\bar{f} = BD + \bar{A}D + \bar{A}C$

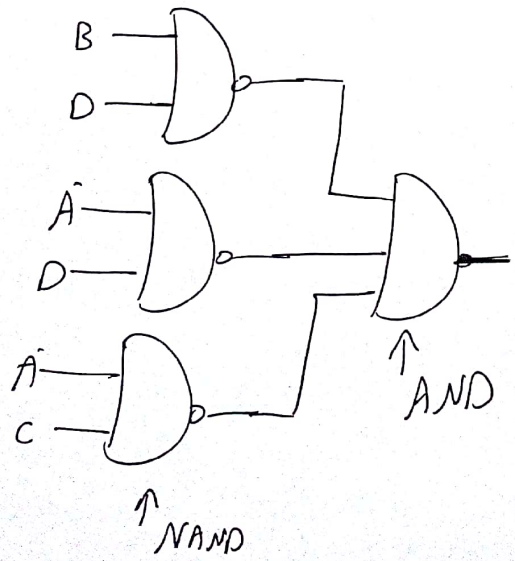
$f = (BD + \bar{A}D + \bar{A}C)'$

a) To Draw using NAND - AND:

$\bar{f} = BD + \bar{A}D + \bar{A}C$

$f = (BD + \bar{A}D + \bar{A}C)'$

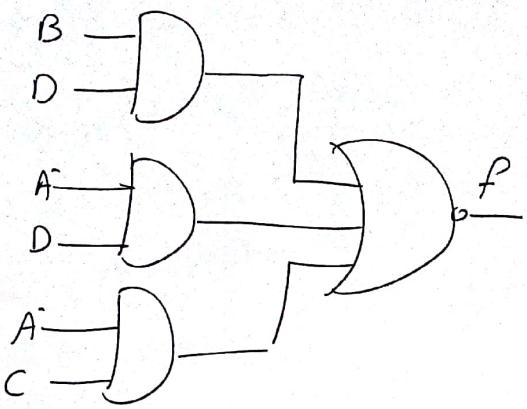
$= (BD)'(\bar{A}D)'(\bar{A}C)'$



b) To draw using AND - NOR

$F' = BD + A'D + A'C$

$F = (BD + A'D + A'C)'$

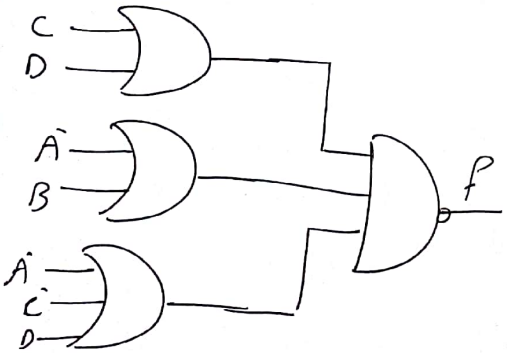


c) To draw using OR - NAND.

$F = C'D' + AB' + ACD'$

$F' = (C + D)(A' + B)(A' + C' + D)$

$F = [(C+D)(A' + B)(A' + C' + D)]'$



d) To draw using NOR - OR.

$F = [(C+D)(A' + B)(A' + C' + D)]'$

$= (C + D)' + (A' + B)' + (A' + C' + D)'$