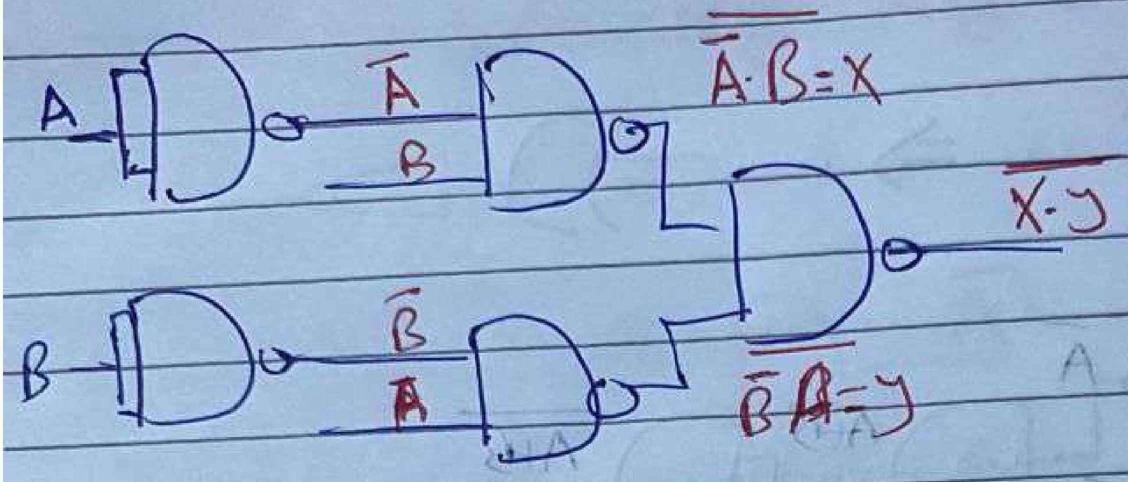
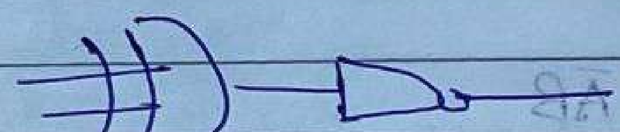


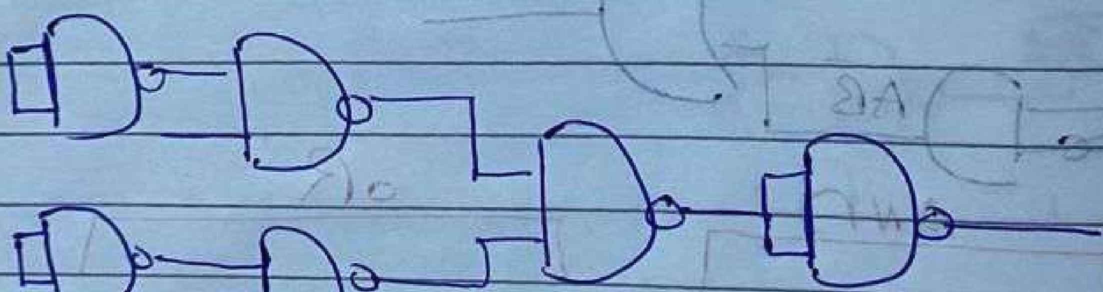
$$\overline{X\cdot y} = \overline{\overline{(\bar{A}\cdot B)}\cdot\overline{(A\cdot\bar{B})}}$$

$$= \overline{\overline{(\bar{A}B)}} + \overline{\overline{(A\bar{B})}}$$

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

6] XNoR





sheet [1] Draw $f = \bar{A}B + A\bar{B}$ using only NAND Gate

[2] Get any Gate from NoR Gate

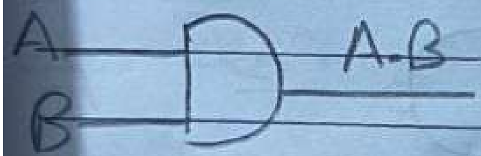
Logic Gates

Circuit ⇒ 0 ⇒ off state ⇒ False
⇒ 1 ⇒ on state ⇒ True

1 Not

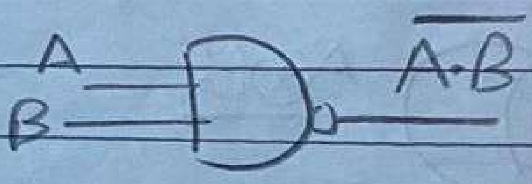
A	out
0	1
1	0

2 AND



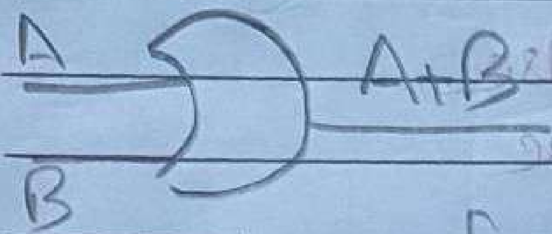
A	B	out
0	0	0
0	1	0
1	0	0
1	1	1

3 NAND



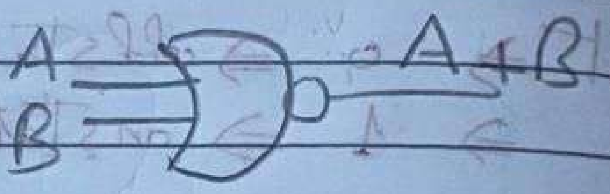
A	B	out
0	0	1
0	1	1
1	0	1
1	1	0

4 OR



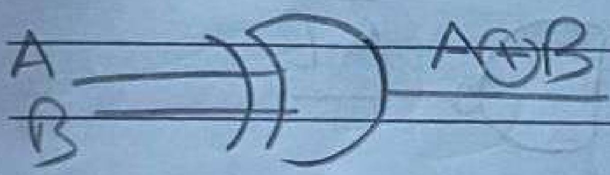
A	B	out
0	0	0
0	1	1
1	0	1
1	1	1

5 NOR



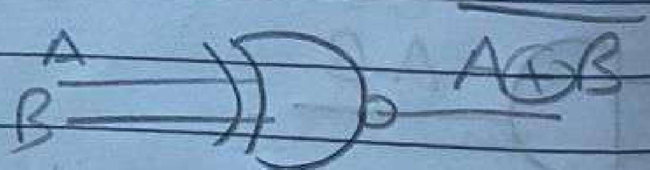
A	B	out
0	0	1
0	1	0
1	0	0
1	1	0

6 XOR



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

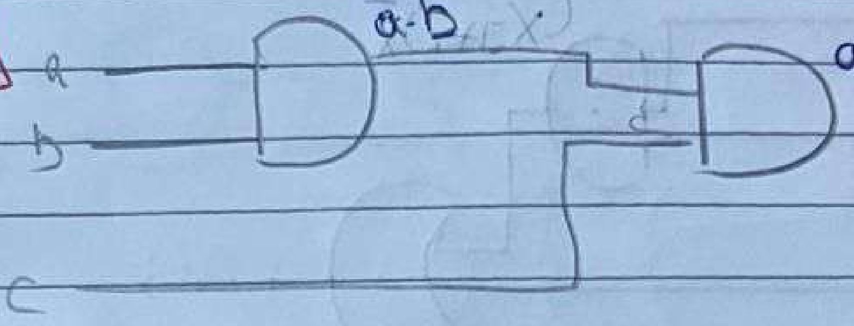
7 XNOR



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

⇒ write a function given a Block Diagram:

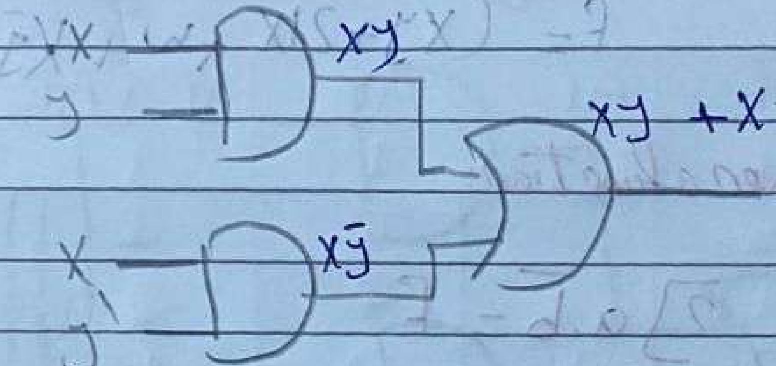
1



a.b.c

$F = a.b.c$

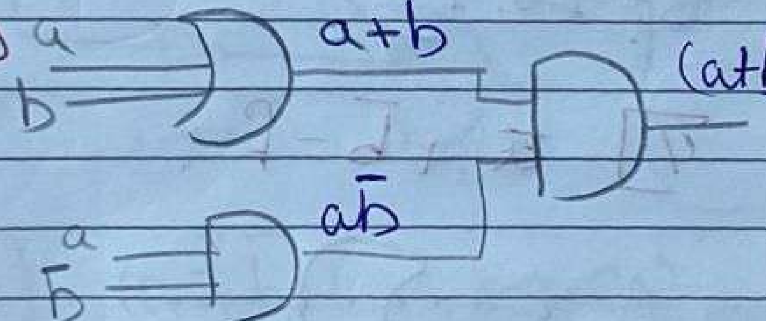
2



xy + xy'

$F = xy + xy'$

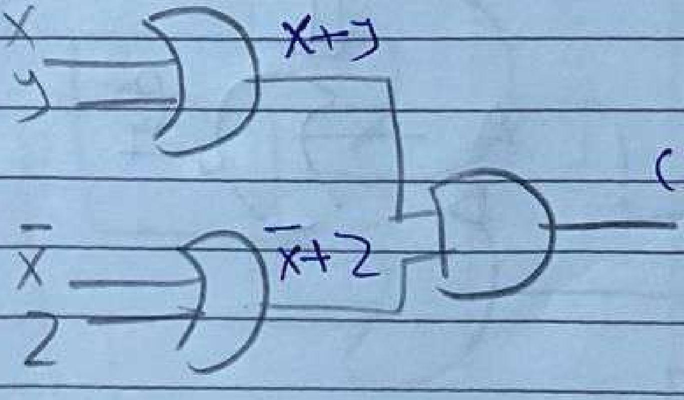
3



(a+b)(ab')

$F = (a+b)(ab')$

4

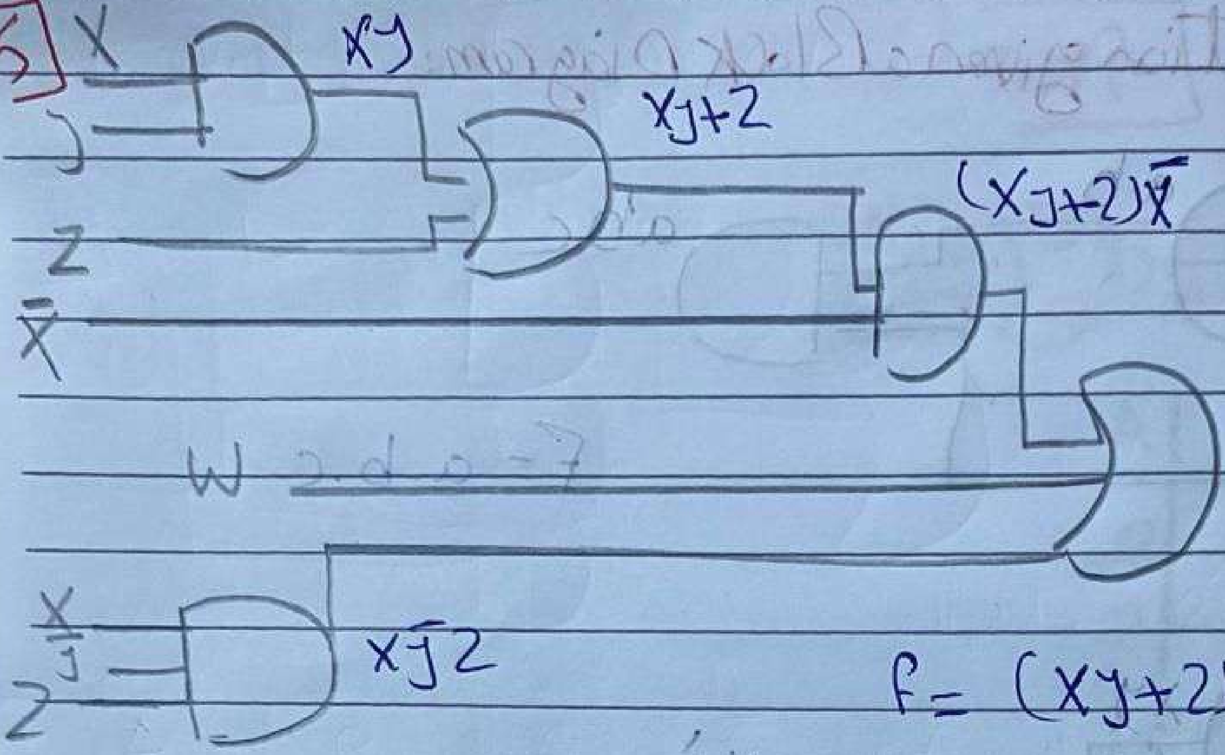


$(x+y)(\bar{x}+z)$

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

Nawar

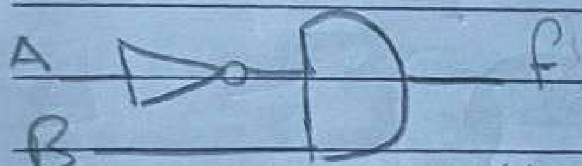
5]



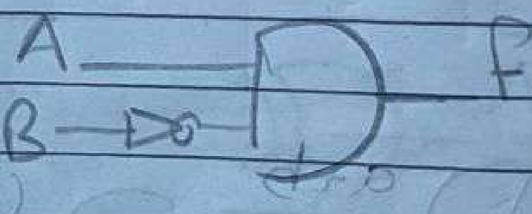
$f = (xy+z)\bar{x} + w + x\bar{y}z$

⇒ Draw a Block Diagram given a function:

1] $\bar{a}.b = f$

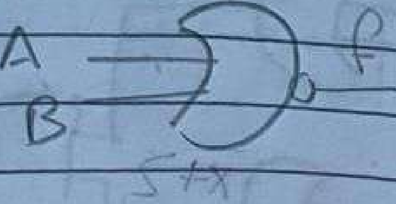


2] $a.\bar{b} = f$

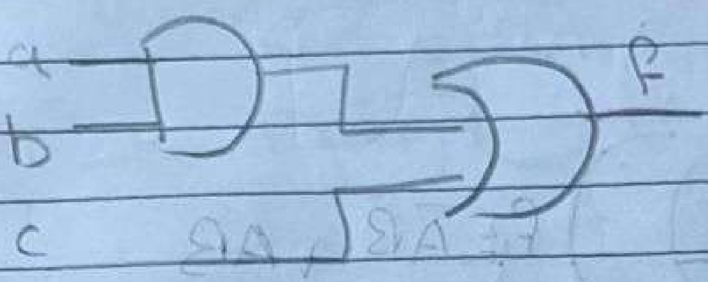


3] $a+b = f$

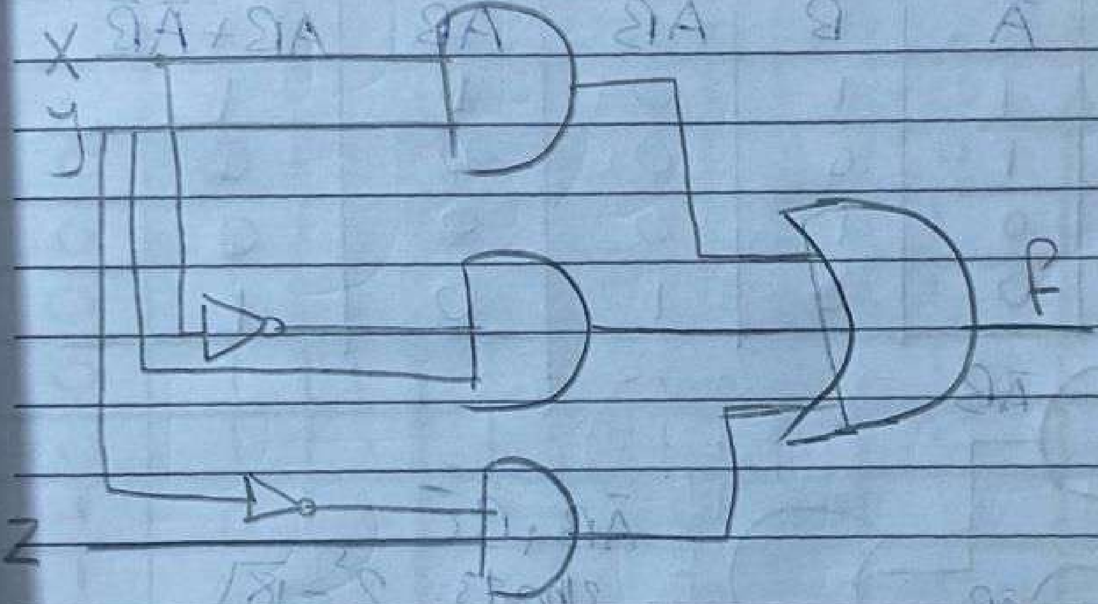
4] $\bar{a} + \bar{b} = f$



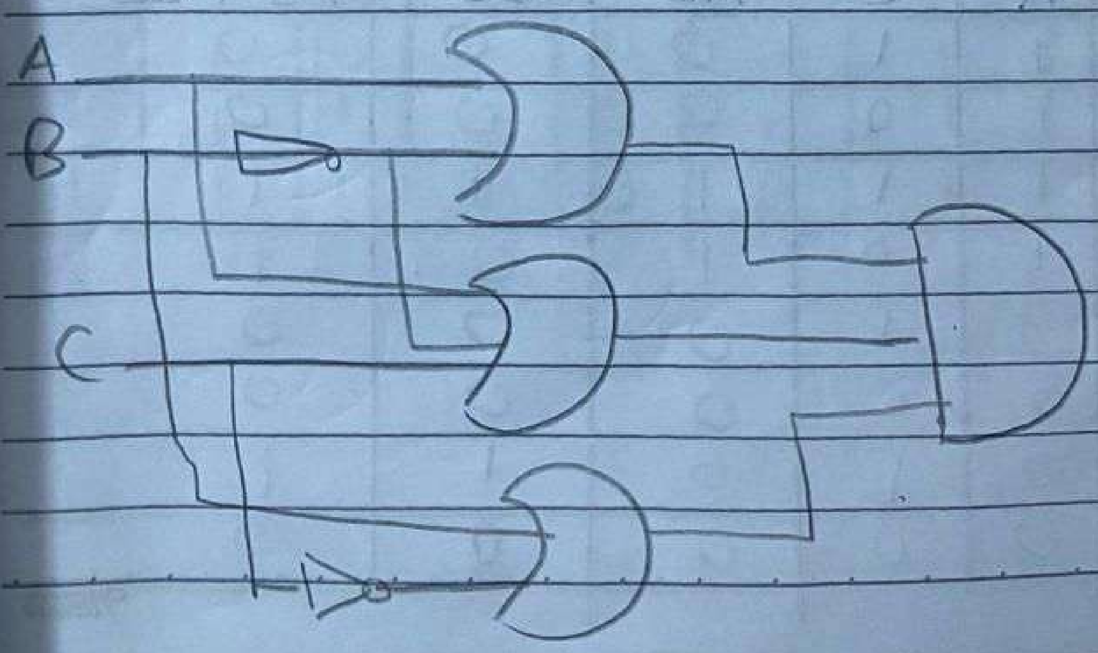
5) $ab + c = f$



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

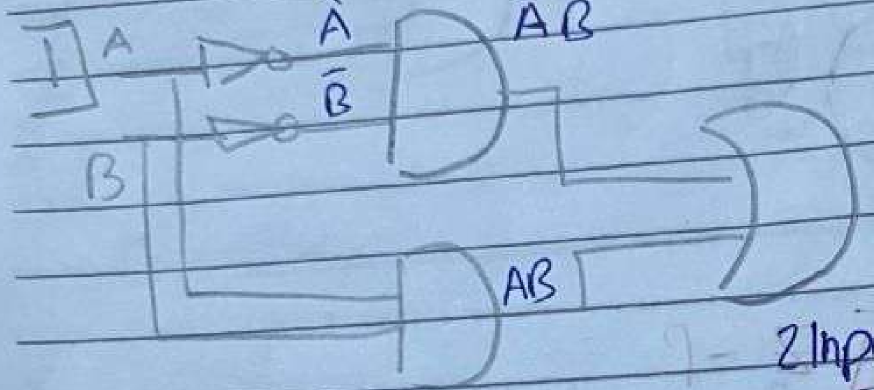


7) $(a+\bar{b})(a+b+c)(b'+c')$



⇒ Conduct a function and Truth table given a Block diagram

1

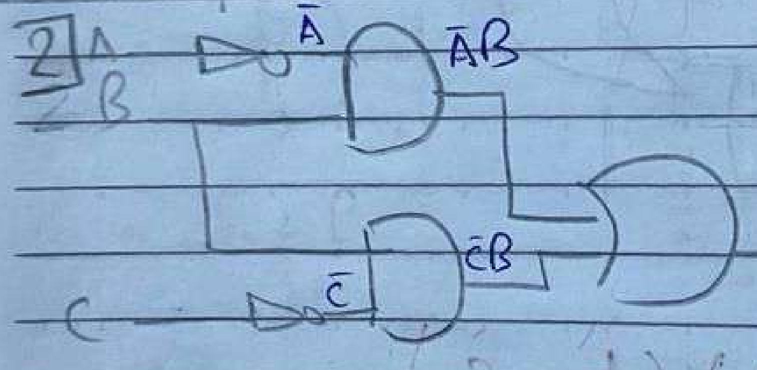


$f = \bar{A}\bar{B} + AB$

2 Inputs $= 2^2 = 4$ possibilities

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

2

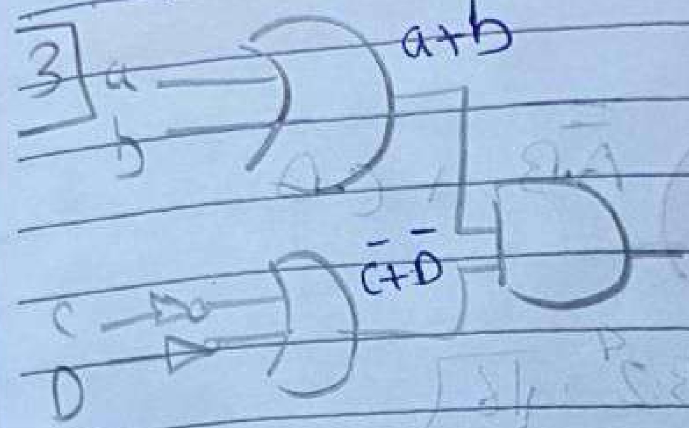


f $\bar{A}B + B\bar{C}$

3 Inputs: $2^3 = \boxed{8}$

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

3]



f $(a+b).(\bar{C}+\bar{D})$

4 inputs : $2^4 = \boxed{16}$

A	B	C	D	$\bar{C}$	$\bar{D}$	A+B	$\bar{C}+\bar{D}$	$(A+B).(\bar{C}+\bar{D})$
0	0	0	0	1	1	0	1	0
0	0	0	1	1	0	0	1	0
0	0	1	0	0	1	0	1	0
0	0	1	1	0	0	0	0	0
0	1	0	0	1	1	1	1	1
0	1	0	1	1	0	1	1	1
0	1	1	0	0	1	1	1	1
0	1	1	1	0	0	1	0	0
1	0	0	0	1	1	1	1	1
1	0	0	1	1	0	1	1	1
1	0	1	0	0	1	1	1	1
1	0	1	1	0	0	1	0	0
1	1	0	0	1	1	1	1	1
1	1	0	1	1	0	1	1	1
1	1	1	0	0	1	1	1	1
1	1	1	1	0	0	1	0	0

PAGE 6
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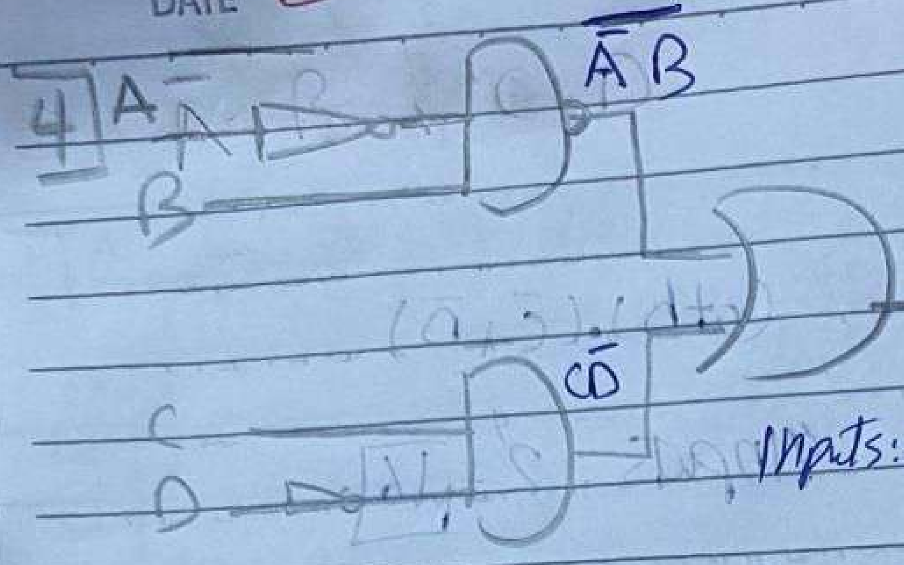
4



$\overline{\bar{A}\cdot B} + C\cdot\bar{D}$

Inputs: 2^4 : $\boxed{16}$

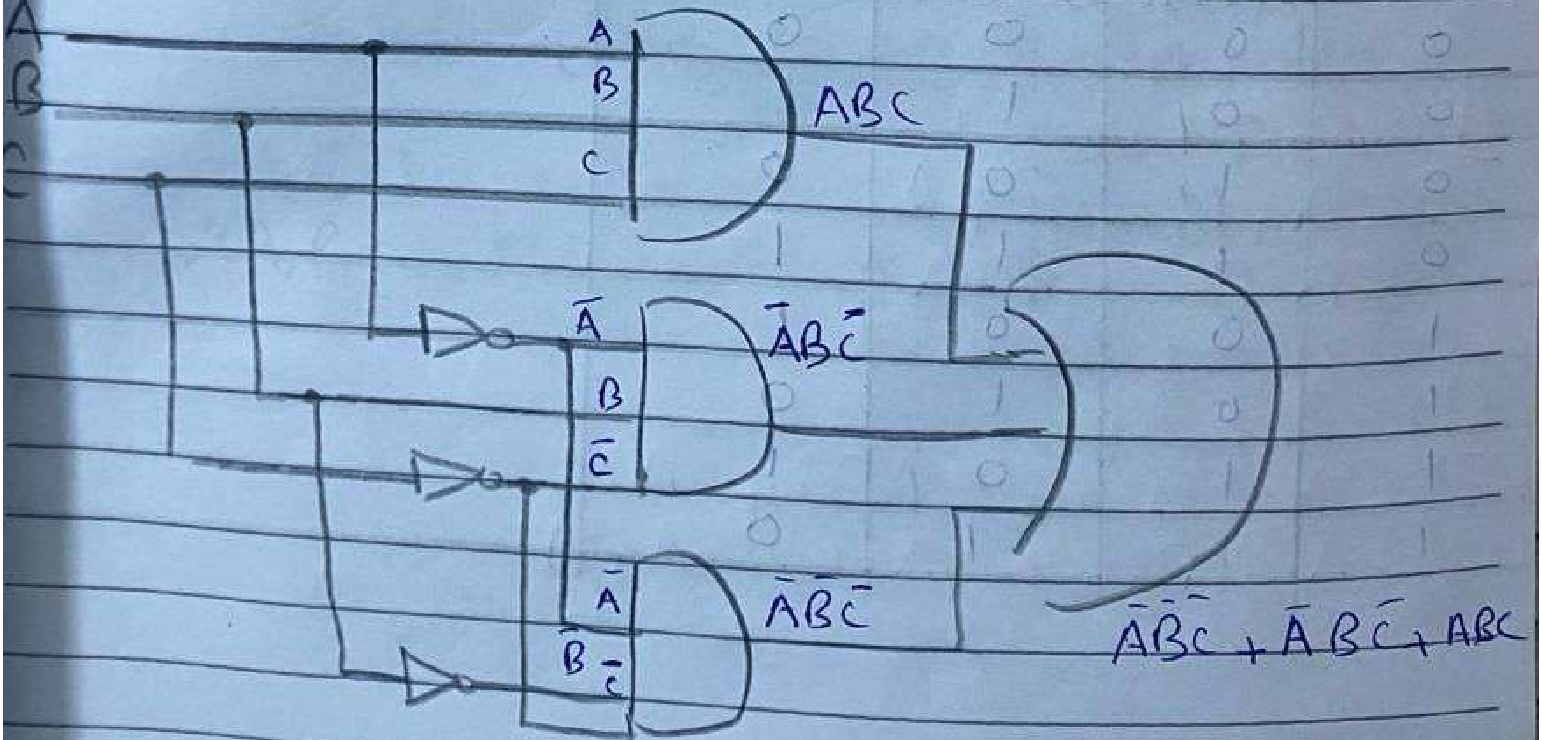
A	B	C	D	$\bar{A}$	$\bar{D}$	$\bar{A}\cdot B$	$\overline{\bar{A}\cdot B}$	$C\cdot\bar{D}$	$\overline{\bar{A}\cdot B} + C\cdot\bar{D}$
0	0	0	0	1	1	0	1	0	1
0	0	0	1	1	0	0	1	0	1
0	0	1	0	1	1	0	1	1	1
0	0	1	1	1	0	0	1	0	1
0	1	0	0	1	1	1	0	0	0
0	1	0	1	1	0	1	0	0	0
0	1	1	0	1	1	1	0	1	1
0	1	1	1	1	0	1	0	0	0
1	0	0	0	0	1	0	1	0	1
1	0	0	1	0	0	0	1	0	1
1	0	1	0	0	1	1	0	1	1
1	0	1	1	0	0	0	1	0	1
1	1	0	0	0	1	0	1	0	1
1	1	0	1	0	0	0	1	0	1
1	1	1	0	0	1	0	1	1	1
1	1	1	1	0	0	0	1	0	1

⇒ Conduct the circuit and function given a truth table:

A	B	C	F
0	0	0	$\boxed{1}$
0	0	1	0
0	1	0	$\boxed{1}$
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	$\boxed{1}$

@ اجعل الـ F=1
@ هكرر الـ Term بعدد الـ F=1 ⇐ الـ Term: حاصل ضرب جميع الـ Inputs
@ لو الـ Input بداخل الـ Term = صفر ⇐ نضع معكوس الـ Input

$$F = \bar{A}\bar{B}\bar{C} + \bar{A}B\bar{C} + ABC$$



⇒ Expressions:

1] SOP Sum of product

$f = ABC + AB\bar{C} + \bar{A}\bar{B}C$

2] POS product of sum

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

3] canonical SOP Σ

$f(A,B,C) = \Sigma(0,1,5,7)$

4] canonical POS Π

$f(A,B,C) = \Pi(2,3,4,6)$

2^{Input}

⇒ Conduct SOP, POS, Σ, Π from Truth Table

A	B	C	F
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

1] Sop:

* هجمع ال Term لكل f = 1 ونعوض ال Inverse لكل Input = صفر

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

2] PoS

* هجمع ال Term لكل f = 0 ونعوض ال Inverse لكل Input = 1

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

3] canonical Sop

* نحول ال Term في ال Sop من ال Binary لل decimal

$F(A,B,C)$: 001 , 011 , 100 , 110

$F(A,B,C) = \Sigma(1, 3, 4, 6)$

4] canonical PoS

* نحول ال Term في ال PoS من ال Binary لل decimal

$F(A,B,C)$: 000 , 010 , 101 , 111

$F(A,B,C) = \Pi(0, 2, 5, 7)$

⇒ Boolean Algebra Rules:

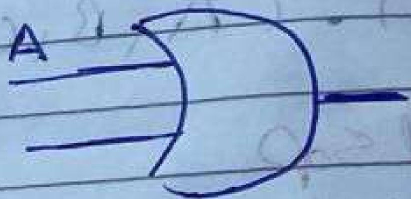
1] Inverse

- $\bar{\bar{A}} = A$
- $\bar{\bar{\bar{A}}} = \bar{A}$

لو النفي زوجي ⇐ الـ A
لو النفي فردي ⇐ الـ $\bar{A}$

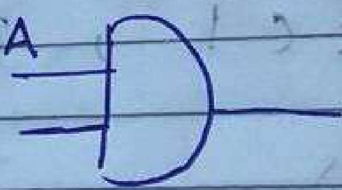
2] Identity & Null using OR circuit

- $A + 0 = A$
- $A + 1 = 1$
- $A + A = A$
- $A + \bar{A} = 1$



3] Identity & Null using AND circuit

- $A \cdot 0 = 0$
- $A \cdot 1 = A$
- $A \cdot A = A$
- $A \cdot \bar{A} = 0$



4] Commutative

- $A + B = B + A$
- $A \cdot B = B \cdot A$

5] Distributive

- $A \cdot (B + C) = (A \cdot B) + (A \cdot C)$
- $A + (B \cdot C) = (A + B) \cdot (A + C)$

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6] Associative:

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

7] Absorption law

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

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

$A.(1+B)+\bar{A}B =$

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

$A+B(A+\bar{A}) =$

$A+B.1 =$

$A+B$ $\Rightarrow \therefore A+\bar{A}B = A+B$

$\therefore \bar{A}+AB = \bar{A}+C$

8] De Morgan's law

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

9] If $y = A+BC$ $\therefore \bar{y} = \overline{A+BC}$

$\bar{y} = \bar{A} . \overline{BC}$

$\bar{y} = \bar{A} . (\bar{B}+\bar{C})$

10] If $y = AB+AB$

$= AB(1+1)$

$= AB(1)$

$= AB$

1] $F = A + AB$

$= A(1 + B)$

$= A(1)$

$= A$

2] $F = AB + AB$

$= A(B + \bar{B})$

$= A(1)$

$= A$

3] $F = A(\bar{A} + B)$

$= A\bar{A} + AB$

$= 0 + AB$

$= AB$

4] $F = AB + BC(B + C)$

$= AB + B\cancel{B}C + BC\cancel{C}$

$= AB + BC + B\cancel{C}$

$= AB + BC$

$= B(A + C)$

5] $F = A\cancel{A} + AC + AB + BC$

$= A + AC + AB + BC$

$= A(1 + C + B) + BC$

$= A(1) + BC$

$= A + BC$

6] $AB + A(A+C) + B(A+C)$

$AB + A\cancel{A} + AC + BA + BC$

$AB + A + AC + \cancel{BA} + BC$

$AB + A + AC + BC$

$A(B + 1 + C) + BC$

$A(1) + BC$

$A + BC$

7] $A.B.C + \bar{A} + A\bar{B}C$

$AC(B + \bar{B}) + \bar{A}$

$AC(1) + \bar{A}$

$AC + \bar{A}$

$AC + \bar{A}.1$

$AC + \bar{A}.(1 + C)$

$AC + \bar{A} + \bar{A}C$

$\bar{A} + C(A + \bar{A})$

$\bar{A} + C(1)$

$= \bar{A} + C$

8] $\bar{A}.\bar{B}.\bar{C} + \bar{A}.\bar{B}.C + \bar{A}.\bar{C}$

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

$\bar{A}\bar{B}(1) + \bar{A}\bar{C}$

$\bar{A}\bar{B} + \bar{A}\bar{C}$

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

$\boxed{9}$ $(A.\bar{B}(C+B.D)+\bar{A}.\bar{B}).C$

$(A\bar{B}C+A\bar{B}BD+\bar{A}\bar{B}).C$

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

$A\bar{B}C\cancel{C}+\bar{A}\bar{B}C$

$A\bar{B}C+\bar{A}\bar{B}C$

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

$\bar{B}C(1)$

$\bar{B}C$

$\boxed{10}$ $\overline{\overline{C\bar{D}+A}+\overline{\bar{C}D+\bar{A}}}$

$=(\overline{\overline{C\bar{D}+A}}).(\overline{\bar{C}D+\bar{A}})$

$=(\overline{C\bar{D}}+A).(\overline{\bar{C}D}.\bar{\bar{A}})$

$=(\overline{C\bar{D}}+A).((\bar{\bar{C}}+\bar{D}).A)$

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

$=(\bar{C}+D+A).(AC+A\bar{D})$

$A\cancel{C}\bar{C}+A\bar{C}\bar{D}+A\cancel{A}C+AC\bar{D}+A\bar{D}\cancel{D}+A\cancel{A}\bar{D}$

$AC\bar{D}+AC+A\bar{C}\bar{D}+A\bar{D}+\cancel{A\bar{D}}$

$AC\bar{D}+AC+A\bar{C}\bar{D}+A\bar{D}$

$AC(\bar{D}+1)+A\bar{C}\bar{D}+A\bar{D}$

$AC + A\bar{C}\bar{D} + A\bar{D}$

$A\bar{D}(\bar{C}+1) + AC$

$A\bar{D} + AC$

$A \cdot (\bar{D} + C)$

II) $\overline{(A+\bar{B})(AB)} + \overline{(A+B)(\bar{A}B)}$

$\overline{(A+\bar{B})} + \overline{(AB)} + \overline{(A+B)} + \overline{\overline{AB}}$

$\overline{(A+\bar{B})} + \overline{AB} + \overline{(A+B)} + \bar{A}B$

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

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

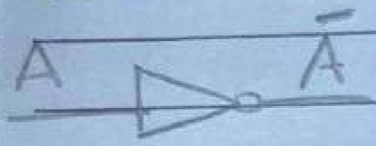
$1 + \bar{B} + \bar{A}(\bar{B} + B)$

$1 + \bar{B} + \bar{A}(1)$

$1 + \bar{B} + \bar{A} = \boxed{1}$

⇒ Using NAND Gate To get any Gate:

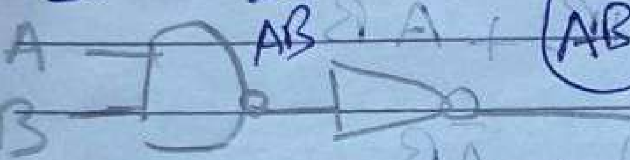
1] Not



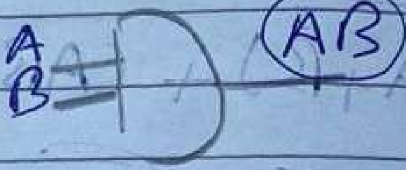
$A \cdot A = A$

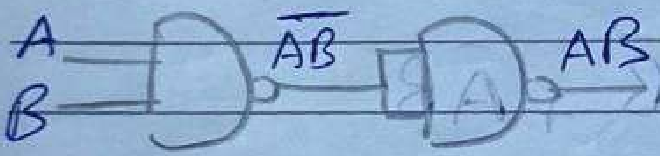
NAND: $\overline{A \cdot A} = \bar{A}$

2] AND



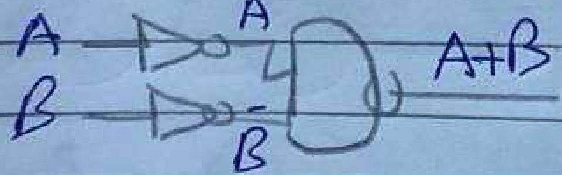
AB

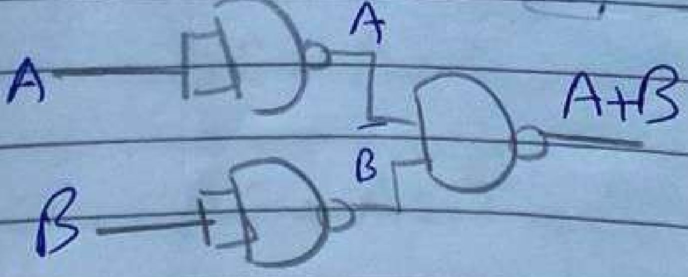




3] OR

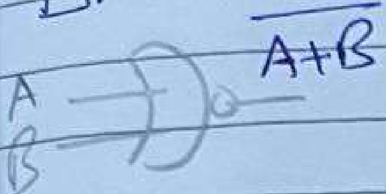
$\overline{AB} = \bar{A} + \bar{B}$

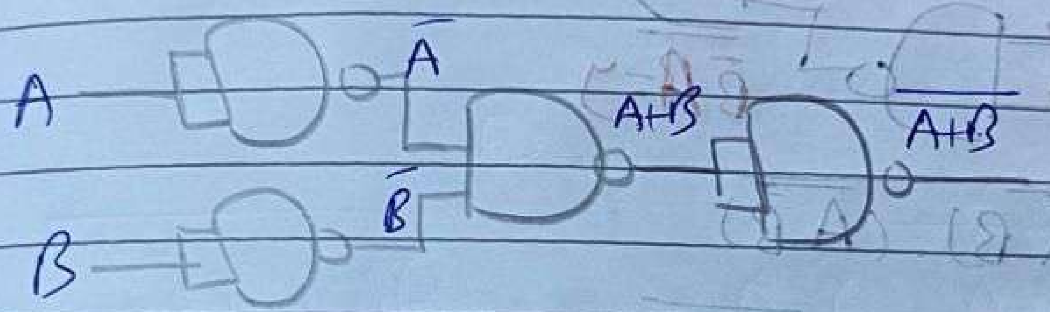




DATE:

4] NoR





5] XoR

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