LOGIC DIAGRAMS

Boolean Expression:

Diagram 1:

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

Diagram 2:

$$\overline{(ac + \bar{a}\bar{c}) + \bar{b}} \cdot \overline{(b+d)\cdot\bar{b}}$$

Diagram 3:

$$\{\overline{\overline{BC} \oplus (\bar{B}C \cdot B)}\} + \overline{\bar{A}\cdot(\bar{B}C\cdot B)}$$

Diagram 4:

$$F = AB + (A \oplus B)C$$
$$G = (A \oplus B) \oplus C$$

Diagram 5:

$$F_1 = \left[\overline{(B+C)\cdot A + (A+\bar{B}) + C}\right]$$
$$F_2 = \left[\overline{(A+\bar{B}) + C \cdot (C \oplus D)}\right]$$
$$F_3 = \left[\overline{(A+\bar{B}) \oplus D}\right]$$

SIMPLIFIED EXPRESSIONS

Diagram 1:

$(X + \bar{Y})Z + \bar{X}\,Y\,\bar{Z}$

$XZ + YZ + \bar{X}YZ$

Diagram 2:

$\overline{(ac + \bar{a}\bar{c}) + \bar{b}} \cdot \overline{(b+d) \cdot b}$

$\overline{(ac + \bar{a}\bar{c}) \cdot \bar{b}} \cdot \overline{(b+d)} + \bar{b}$

$\overline{(a \oplus c) \cdot \bar{b}} \cdot \overline{(b+d)} + \bar{b}$

$(a \oplus c) \cdot b \cdot [(\bar{b} \cdot \bar{d}) + b]$

$[\bar{a}bc + ab\bar{c}] \cdot [b + \bar{b}\bar{d}]$

$\bar{a}b \cdot bc + \bar{a}b\bar{b}\bar{d}c + ab\bar{c}b + ab\bar{b}\bar{c}\bar{d}$

$\because c \cdot \bar{c} = 0$ or $b \cdot b = b$

$\bar{a}bc + ab\bar{c}$

$b(\bar{a}c + a\bar{c})$ or $b(a \oplus c)$

Diagram 3:

$\{\overline{\bar{B}C} \oplus (\overline{B\bar{C}} \cdot B)\} + \overline{\bar{A} \cdot \overline{BC} \cdot B}$

$\{BC \oplus (\bar{B} + \bar{C}) \cdot B\} + \{A + \overline{(\overline{BC} \cdot B)}\}$

$\{BC \oplus B\bar{C}\} + \{A + (\overline{B\bar{C}} + \bar{B})\} \rightarrow \bar{B} + BC = \bar{B} + C$

$\{\overline{BC} \cdot B\bar{C} + BC \cdot (\overline{B\bar{C}})\} + \{A + \bar{B} + \bar{C}\}$

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

$B\bar{C} + BC + A + \bar{B} + C \quad \because C + \bar{C} = 1$

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

$B + B + A + C$

$1 + A + C = 1$

Diagram 4:

For F:

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

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

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

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

$AB + AC + \bar{A}BC$

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

$AB + C(A + B)$

$F = AB + AC + BC$.

For G:

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

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

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

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

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

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

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

Diagram 5:

For F_1:

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

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

$[(\bar{B} \cdot \bar{C}) + \bar{A}] \cdot (\bar{A}B\bar{C})$

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

$\because B \cdot \bar{B} = 0$

$F_1 = \bar{A}B\bar{C}$

For F_2:

$$\overline{(A+\bar{B})+C} + \overline{(CD+\bar{C}\bar{D})}$$

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

$$[\overline{(\bar{A}\cdot B)}\cdot\bar{C}] + [(\bar{C}+\bar{D})\cdot(\bar{\bar{C}}+\bar{\bar{D}})]$$

$$F_2 = \bar{A}B\bar{C} + (C \oplus D)$$

For F_3:

$$\overline{(\bar{A}+\bar{B})\cdot D}\cdot\overline{\bar{D}(A+\bar{B})}$$

$$[\overline{(A+\bar{B})}+\bar{D}]\cdot[D+\overline{(A+\bar{B})}]$$

$$[(A+\bar{B})+\bar{D}\cdot[D+\bar{A}\cdot\bar{\bar{B}}]$$

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

$$AD+\bar{B}D+0+0+\bar{A}B\bar{D}$$

$$F_3 = AD+\bar{B}D+\bar{A}B\bar{D}$$

SOP OR POS

Diagram 1:

SOP:

$\bar{X}\bar{Y}Z + \bar{X}Y\bar{Z} + X\bar{Y}Z + XYZ$

POS:

$(X+Y+Z)(X+\bar{Y}+\bar{Z})(\bar{X}+Y+Z)$

Diagram 2:

SOP:

$(\bar{a}bcd) + (\bar{a}bc\bar{d}) + (ab\bar{c}d) + (ab\bar{c}\bar{d})$

POS:

$(a+b+c+d)(a+b+c+\bar{d})(a+b+\bar{c}+d)$
$(a+b+\bar{c}+\bar{d})(a+\bar{b}+c+d)(a+\bar{b}+c+\bar{d})$
$(\bar{a}+b+c+d)(\bar{a}+b+c+\bar{d})(\bar{a}+b+\bar{c}+\bar{d})$
$(\bar{a}+b+\bar{c}+d)(\bar{a}+\bar{b}+\bar{c}+d)(\bar{a}+\bar{b}+\bar{c}+\bar{d})$

Diagram 3:

SOP:

NO SOP

POS:

NO POS

Diagram 4:

SOP For F:

$\bar{A}BC + A\bar{B}C + AB\bar{C} + ABC$

SOP For 4:

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

POS For F:

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

POS For 4:

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

Diagram 5:

SOP For F_1:

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

SOP For F_2:

$(\bar{A}\bar{B}\bar{C}D) + (\bar{A}\bar{B}C\bar{D}) + (\bar{A}B\bar{C}\bar{D}) + (\bar{A}BC\bar{D}) + (\bar{A}BCD) + (A\bar{B}\bar{C}D) + (A\bar{B}C\bar{D}) + (AB\bar{C}D) + (ABC\bar{D})$

SOP For F_3:

$(\bar{A}\bar{B}\bar{C}D) + (\bar{A}\bar{B}CD) + (\bar{A}B\bar{C}\bar{D}) + (\bar{A}BC\bar{D}) + (A\bar{B}\bar{C}D) + (A\bar{B}CD) + (AB\bar{C}D) + (ABC\bar{D}) + (ABCD)$

POS For F_1:

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

POS for F_2:

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

POS for F_3:

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

TRUTH TABLES

Diagram. 1:

A	B	C	AC	$\bar{B}C$	$\bar{X}YZ$	$AC+\bar{B}C+\bar{A}BC$
0	0	0	0	0	0	0
0	0	1	0	1	0	1
0	1	0	0	0	0	0
0	1	1	0	0	1	1
1	0	0	0	0	0	0
1	0	1	1	1	0	1
1	1	0	0	0	0	0
1	1	1	1	0	0	1

Diagram 2:

a	b	c	d	$a \oplus c$	$b(a+c)$
0	0	0	0	0	0
0	0	0	1	0	0
0	0	1	0	1	0
0	0	1	1	1	0
0	1	0	0	0	0
0	1	0	1	0	0
0	1	1	0	1	1
0	1	1	1	1	1
1	0	0	0	1	0
1	0	0	1	1	0
1	0	1	0	0	0
1	0	1	1	0	0
1	1	0	0	1	1
1	1	0	1	1	1
1	1	1	0	0	0
1	1	1	1	0	0

Diagram 3

A	B	C	1
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	1

Diagram 4:

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

Diagram 5:

A	B	C	D	F_1	F_2	F_3
0	0	0	0	0	0	0
0	0	0	1	0	1	1
0	0	1	0	0	1	0
0	0	1	1	0	0	1
0	1	0	0	1	1	1
0	1	0	1	1	1	0
0	1	1	0	0	1	1
0	1	1	1	0	0	0
1	0	0	0	0	0	0
1	0	0	1	0	1	1
1	0	1	0	0	1	0
1	0	1	1	0	0	1
1	1	0	0	0	0	0
1	1	0	1	0	1	1
1	1	1	0	0	1	1
1	1	1	1	0	0	1

AND OR NOT Diagrams

Diagram 1:

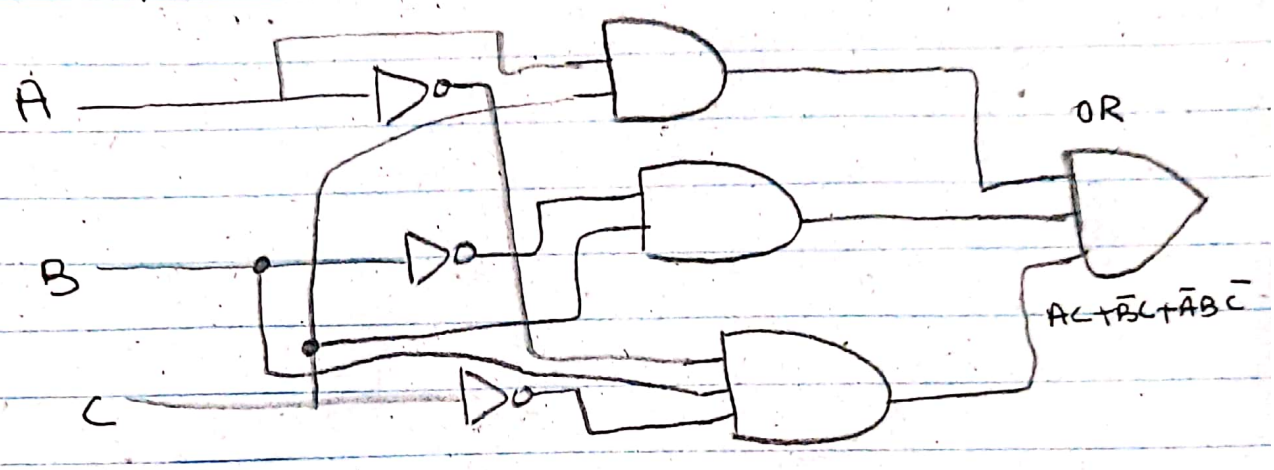


Diagram 2:

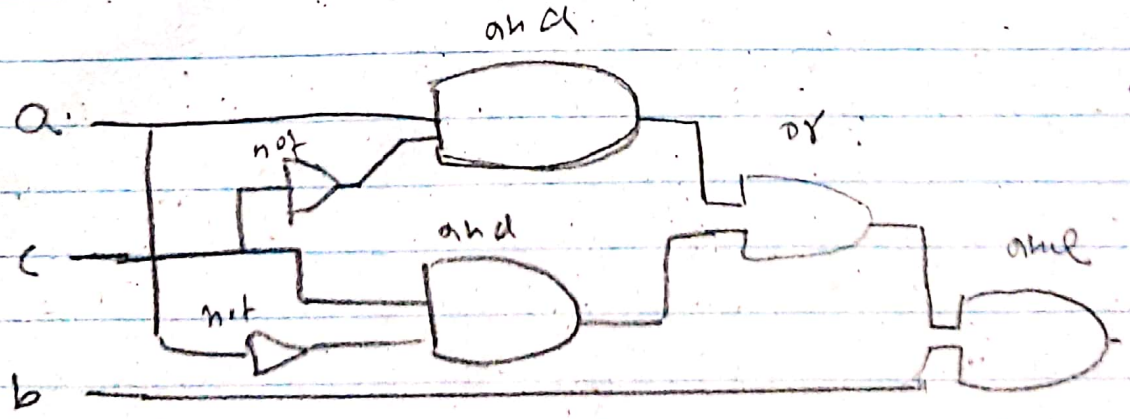


Diagram 3:

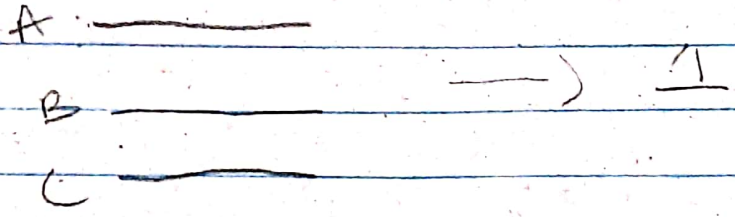


Diagram 4:

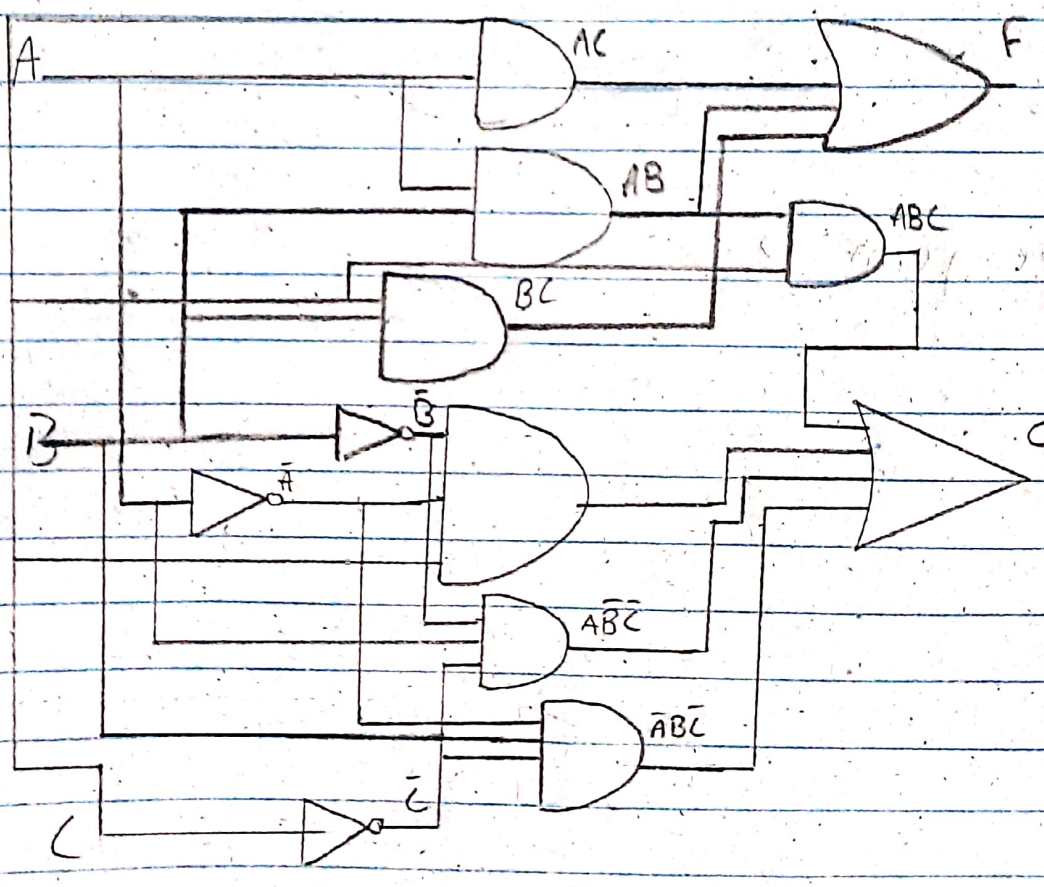
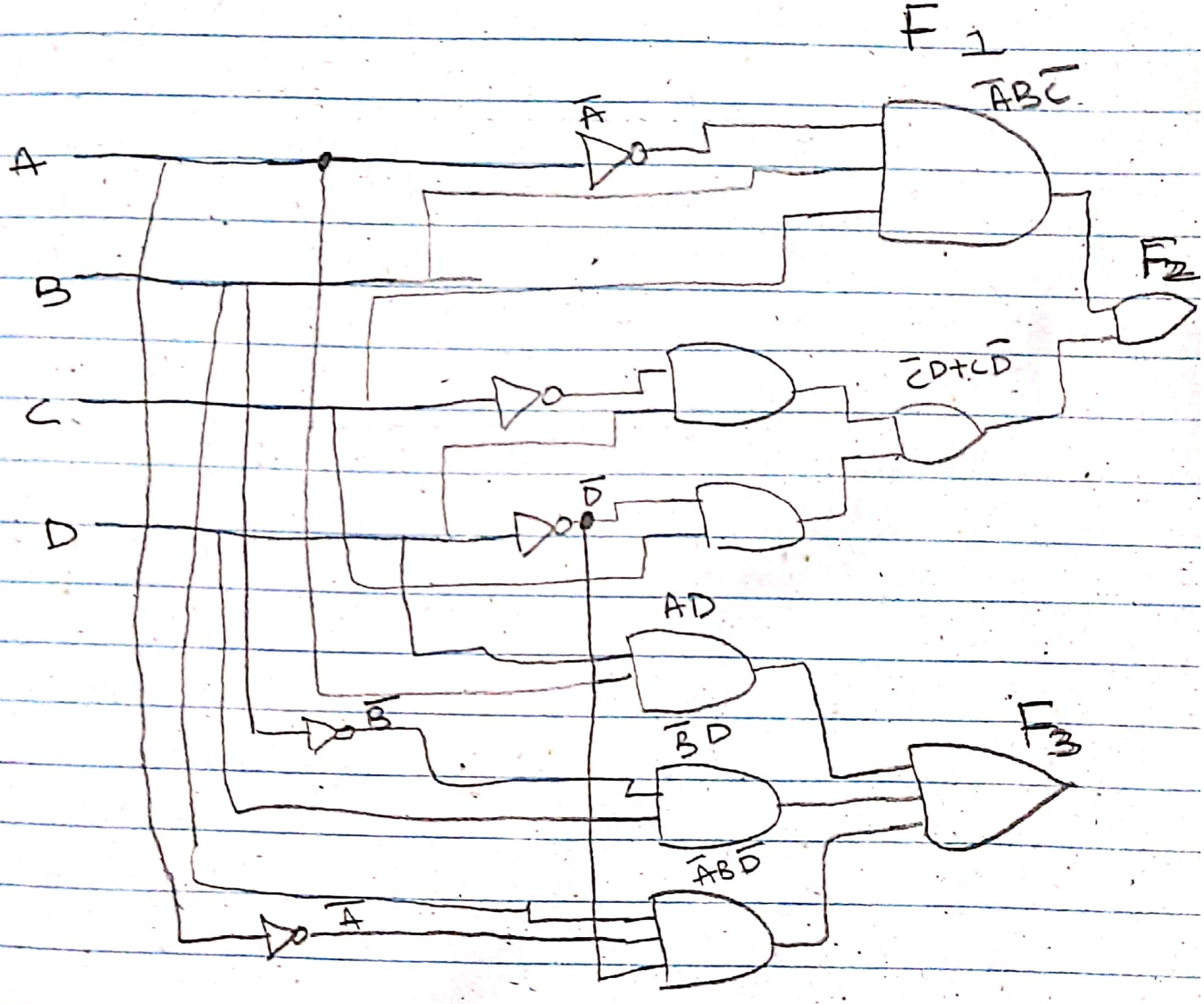


Diagram 5:



NAND GATE

Diagram 1:

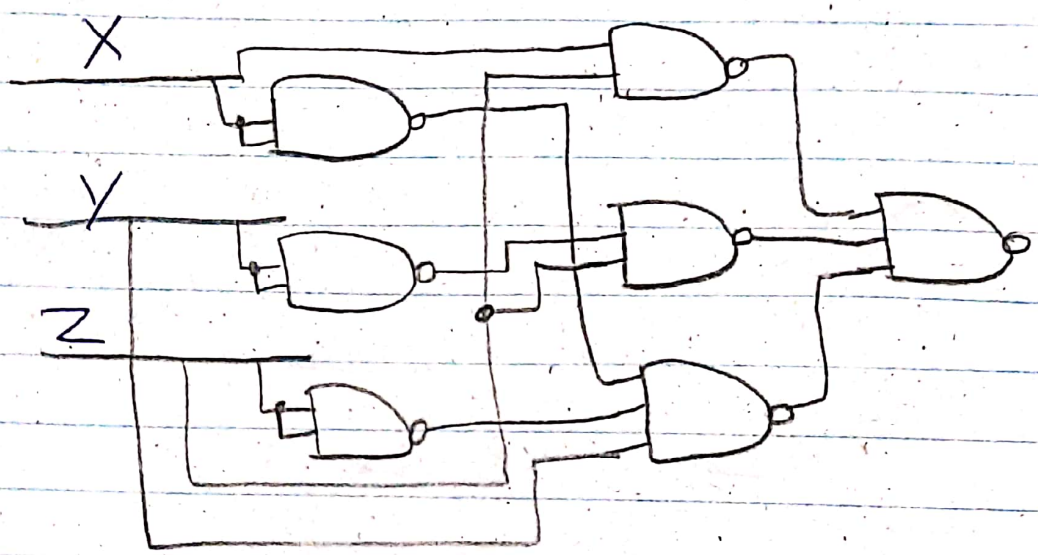
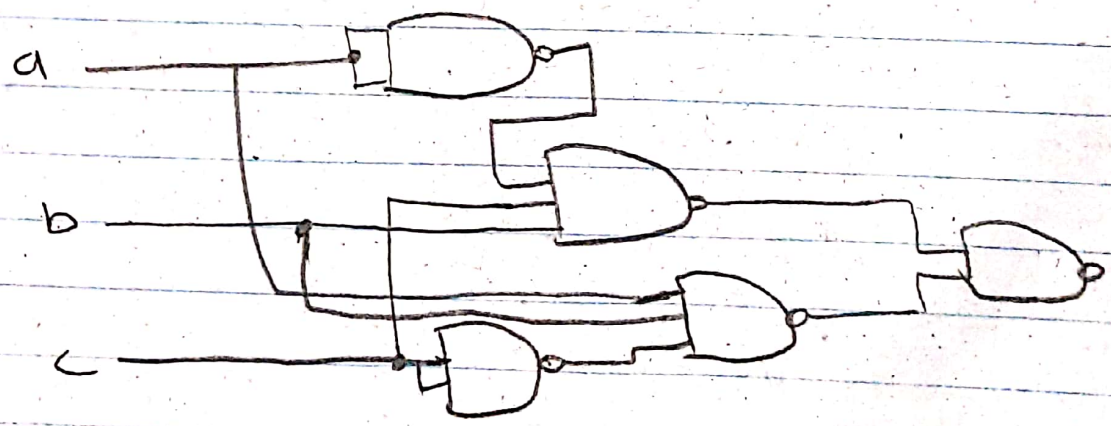


Diagram 2:



d no effect.

Diagrams 3:

No diagram required because each input give 1.

Diagram 4:

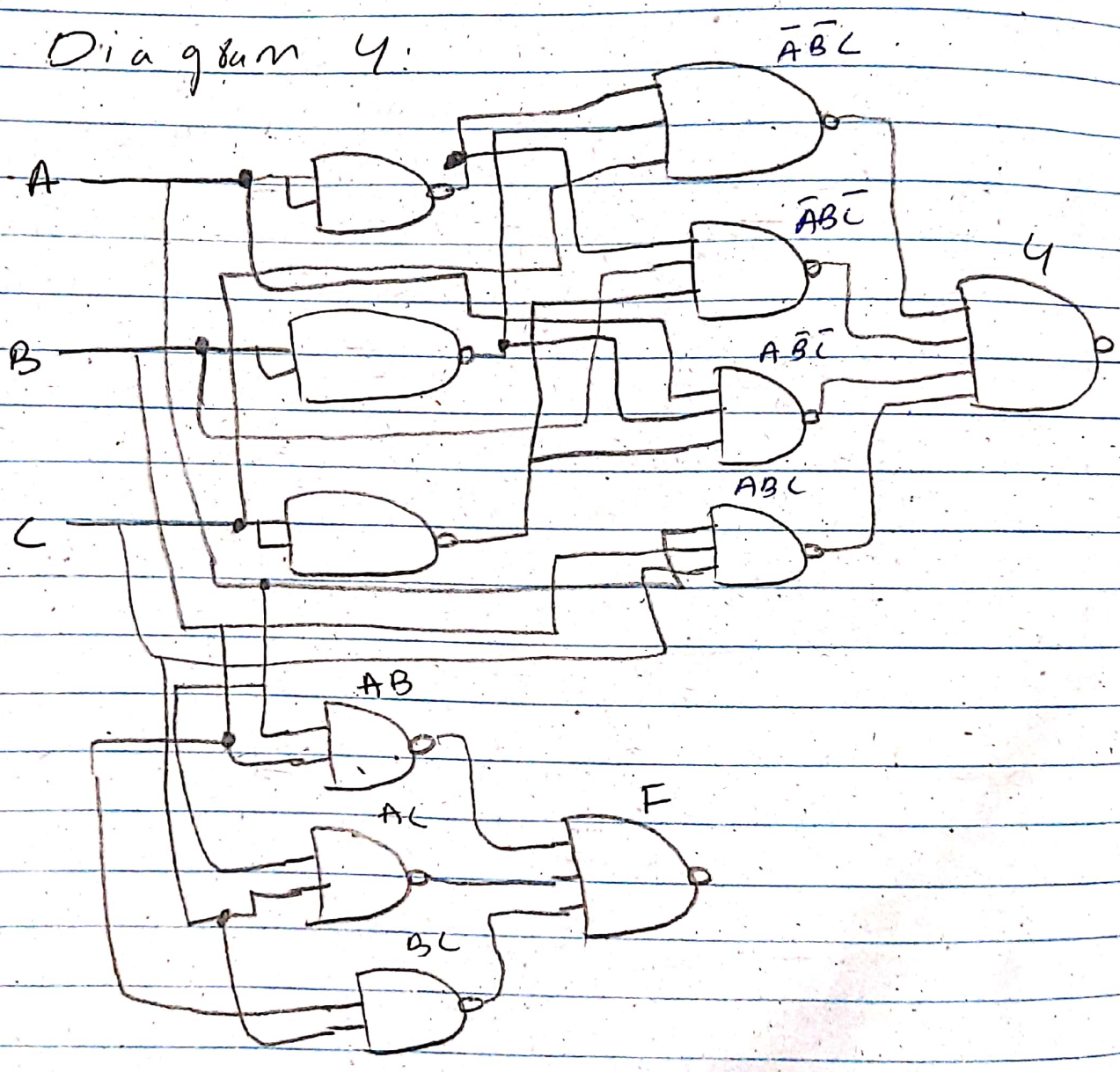
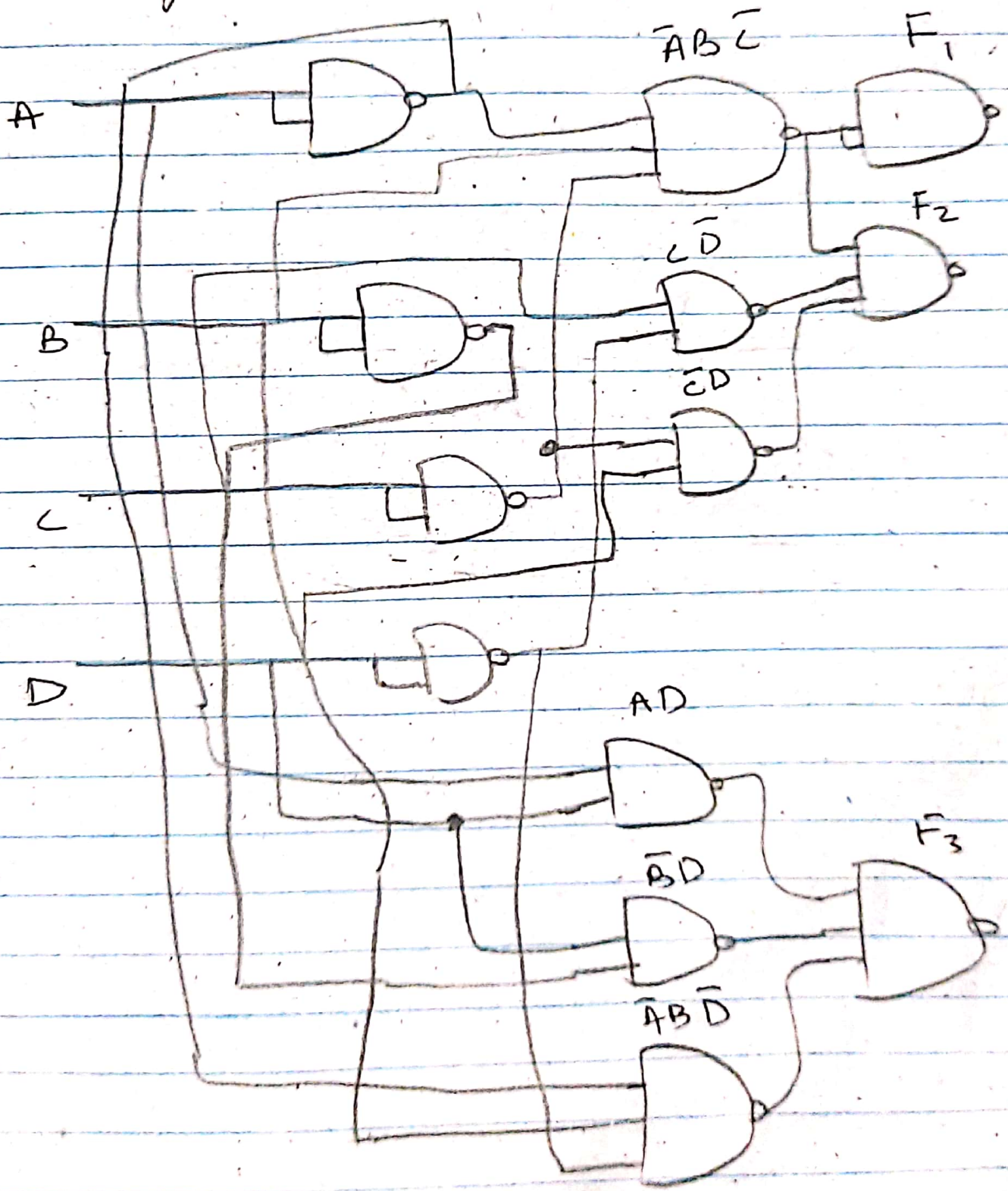


Diagram 5:



NOR GATE

Diagram 1:

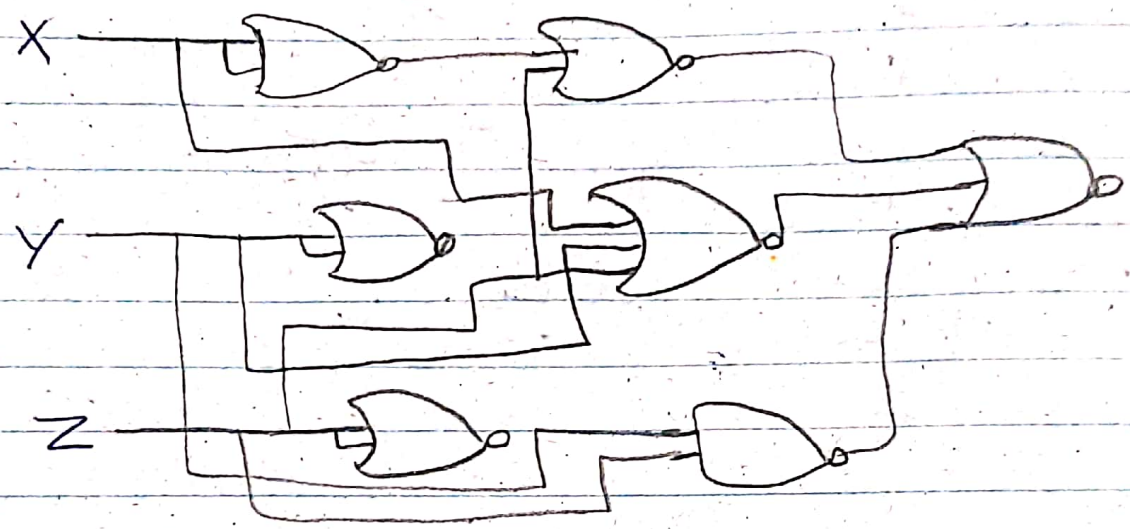
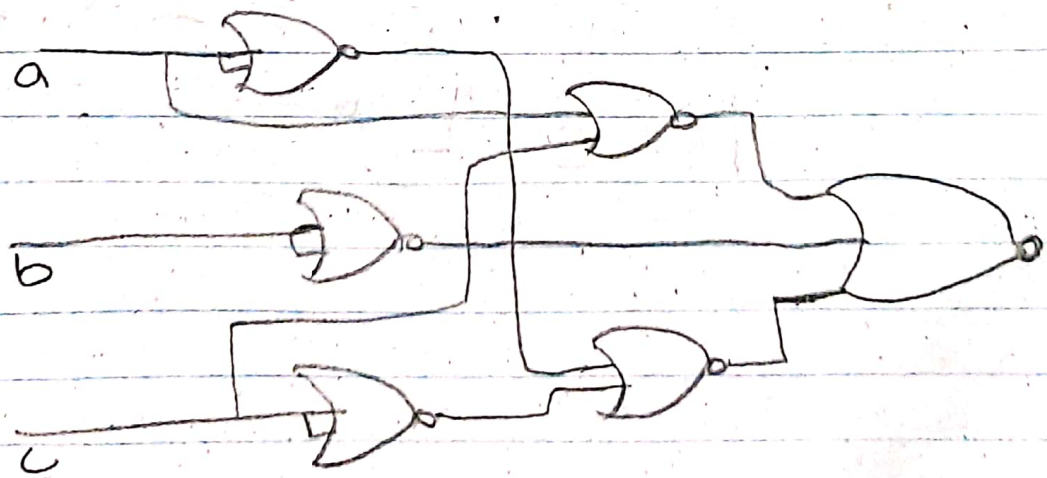


Diagram 2:



d has no effect

Diagram 3:

All input give 1 so no diagram required.

Diagram 4:

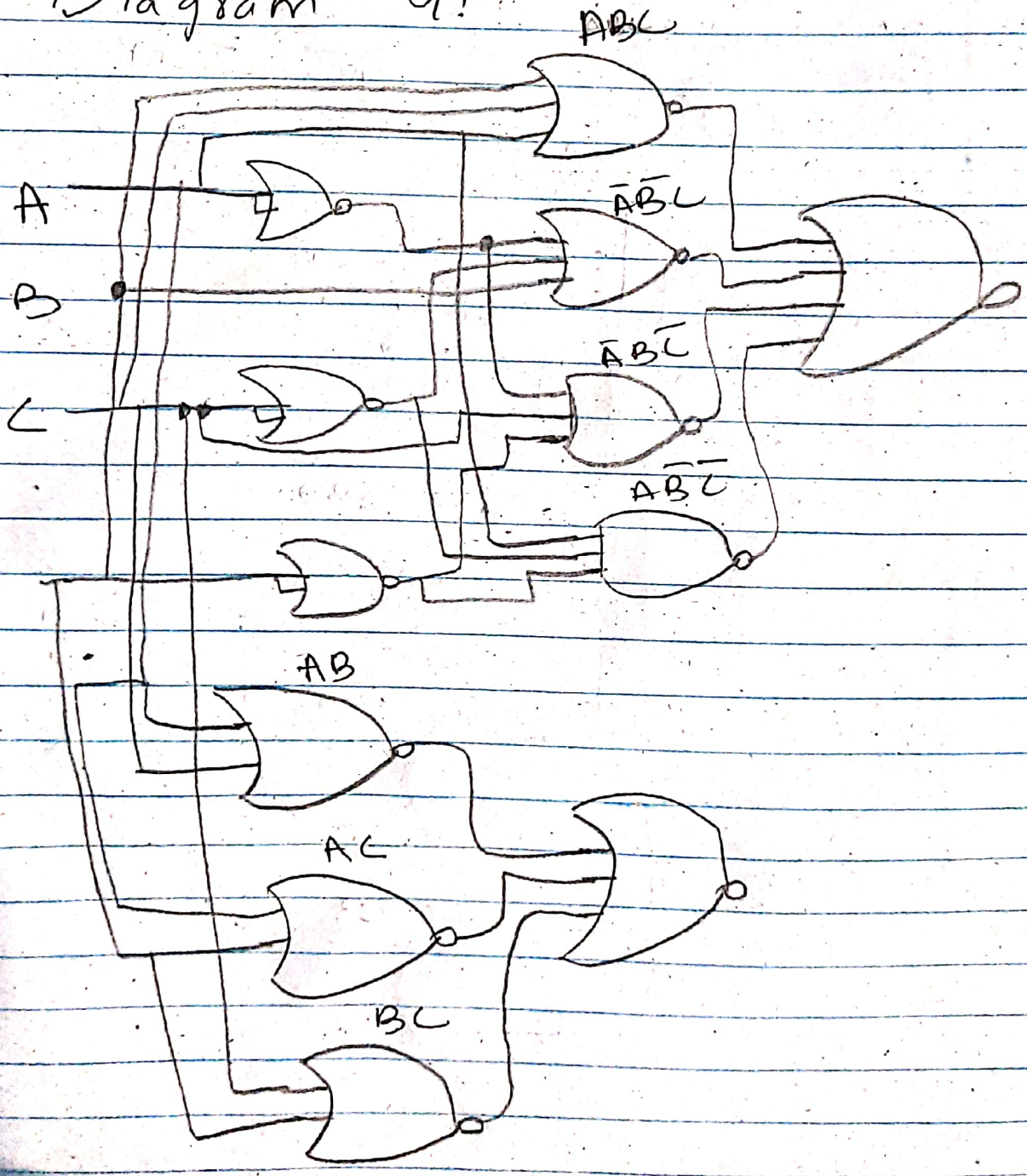
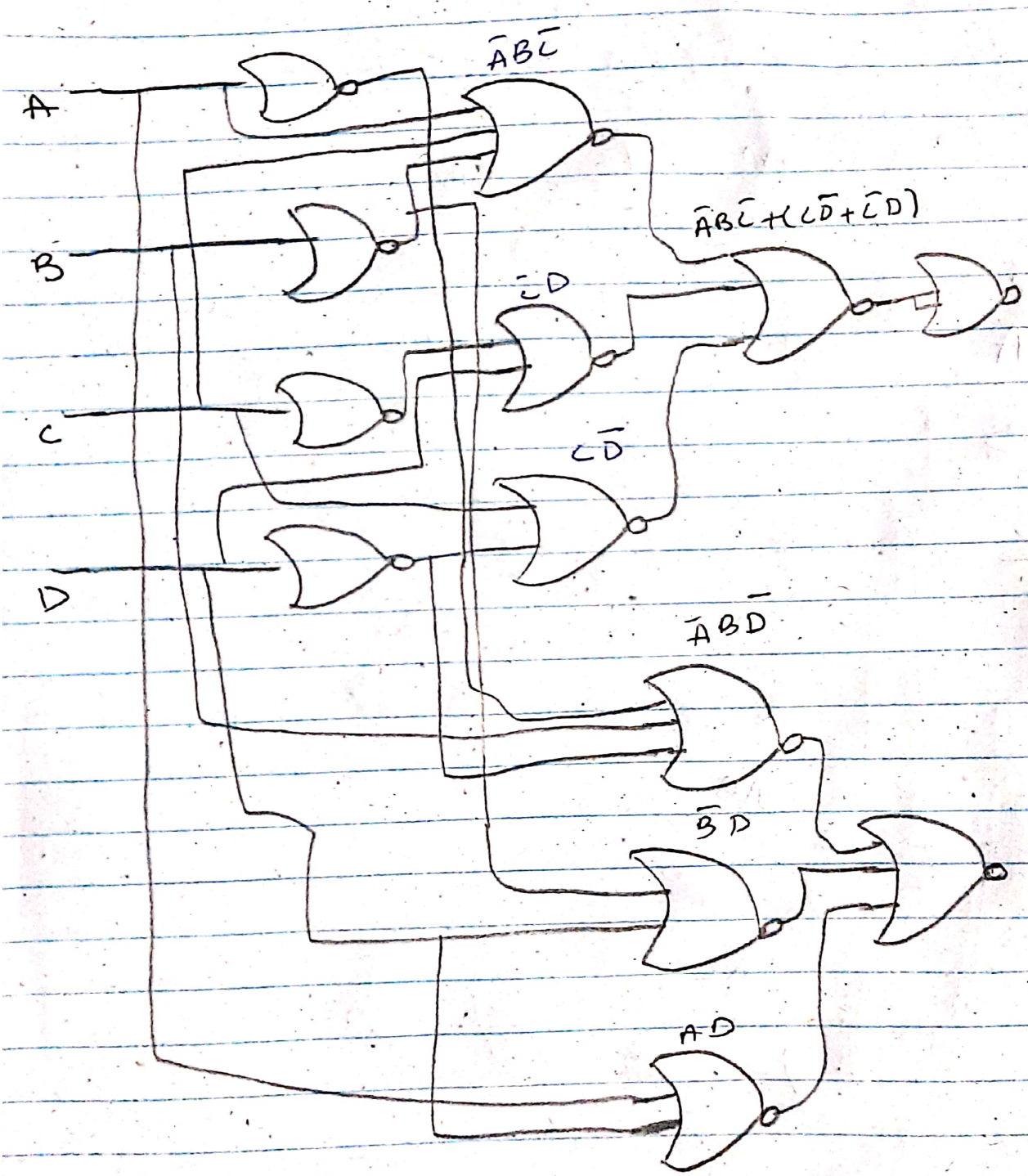


Diagram 5:



WORD PROBLEMS

1)

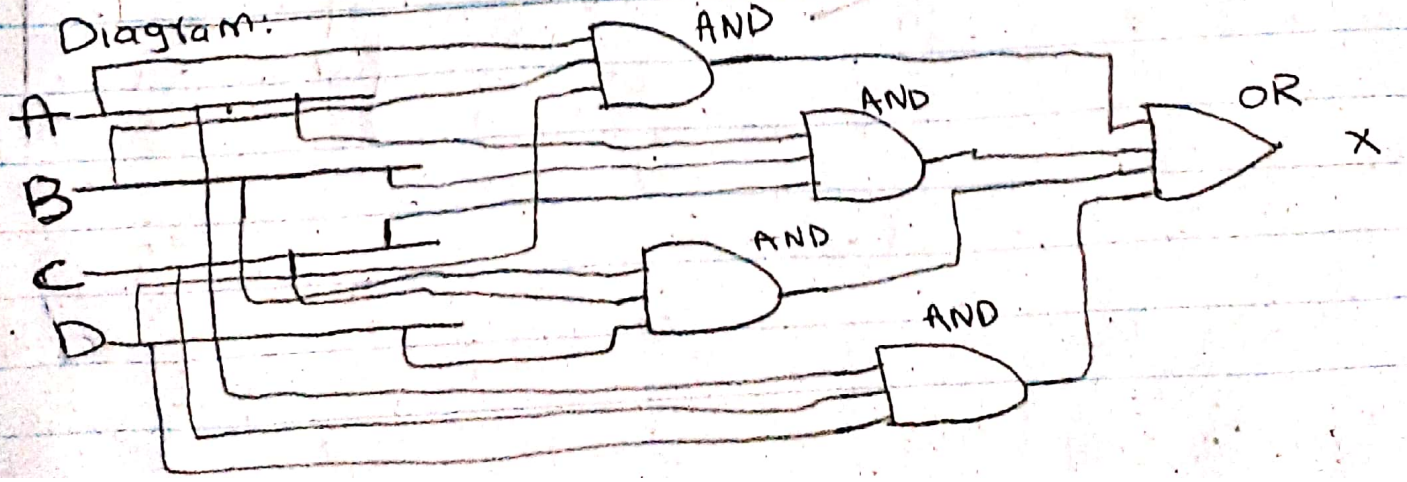
A	B	C	D	X
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	1
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

AB \ CD	00	01	11	10
00				
01			1	
11		1	1	1
10			1	

simplified:

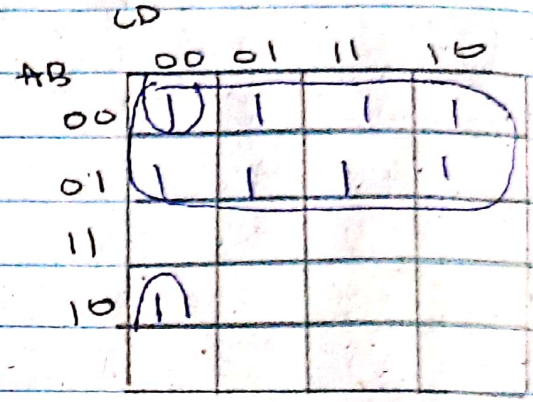
ABD + ABC + BCD + ALD

Diagram:



2)

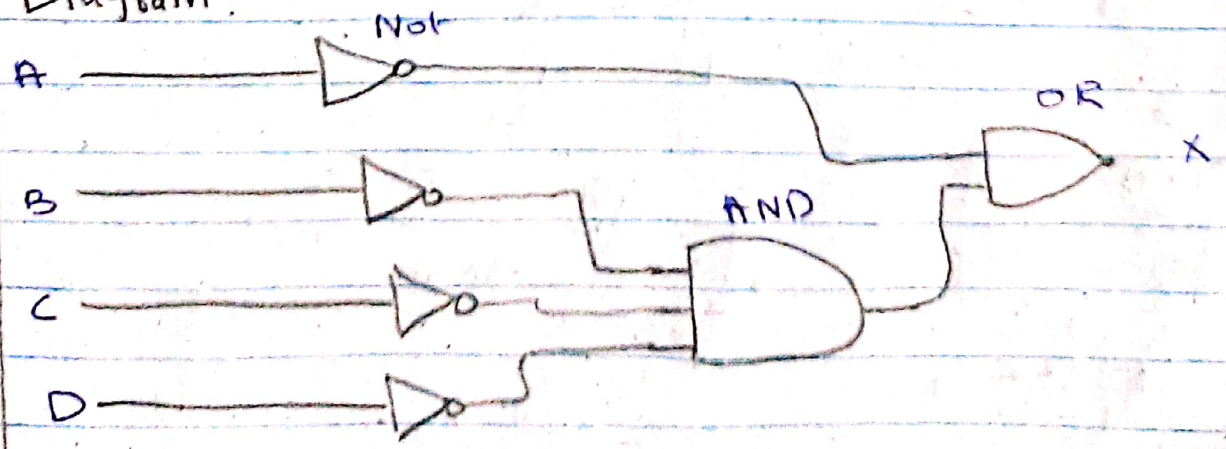
A	B	C	D	X
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	1
0	1	0	0	1
0	1	0	1	1
0	1	1	0	1
0	1	1	1	1
1	0	0	0	1
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	0
1	1	0	1	0
1	1	1	0	0
1	1	1	1	0



Simplified:

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

Diagram:



A	B	C	D	Z	Y
0	0	0	0	0	1
0	0	0	1	1	0
0	0	1	0	0	1
0	0	1	1	1	0
0	1	0	0	0	1
0	1	0	1	1	0
0	1	1	0	0	1
0	1	1	1	1	0
1	0	0	0	0	1
1	0	0	1	1	0
1	0	1	0	0	1
1	0	1	1	1	0
1	1	0	0	0	1
1	1	0	1	1	0
1	1	1	0	0	1
1	1	1	1	1	0

CD

AB	00	01	11	10
00		1	1	
01	1	1	1	
11		1	1	
10		1	1	

Simplified Z:

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

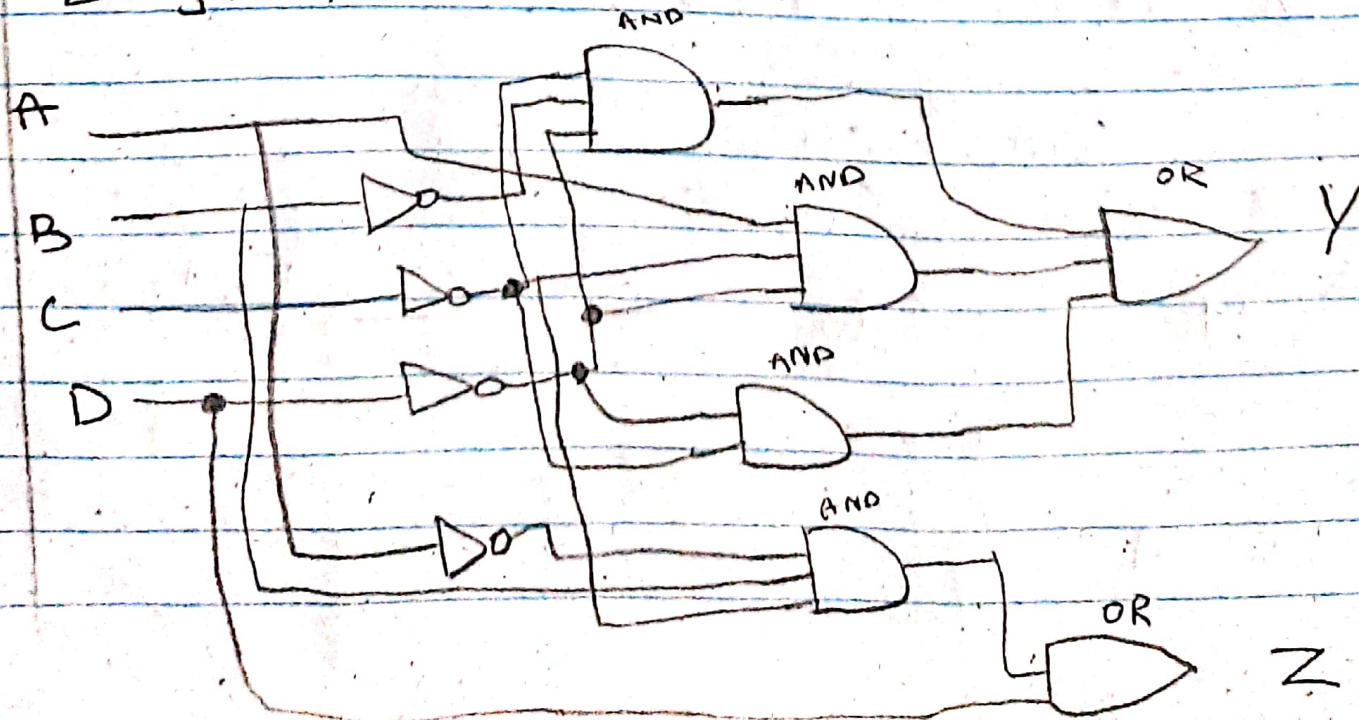
CD

AB	00	01	11	10
00	1			1
01				1
11	1			1
10	1			1

Simplified Y:

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

Diagram:



4) Given

P = 0 when G = 1 S = 1

and P = 0 when M = 0 S = 0

G Logic 0	S Logic 1	M	P
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	0

A \ BC	00	01	11	10
0	0			
1	0		0	0

$(S+M)\cdot(\bar{G}+\bar{S})$

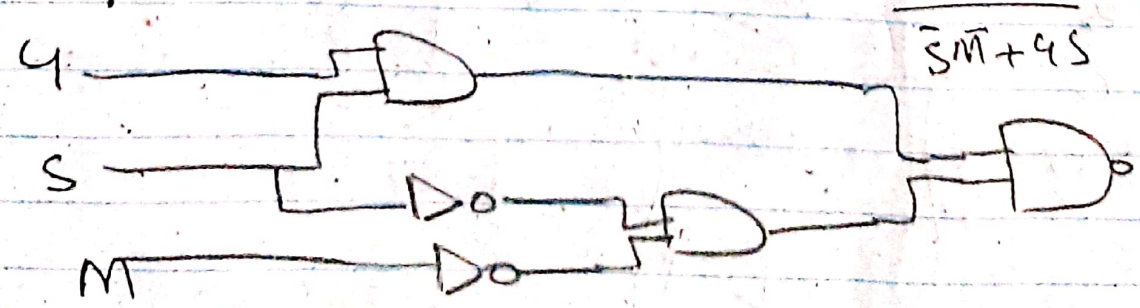
For AND OR invert

$(S+M)\cdot(\bar{G}+\bar{S})$

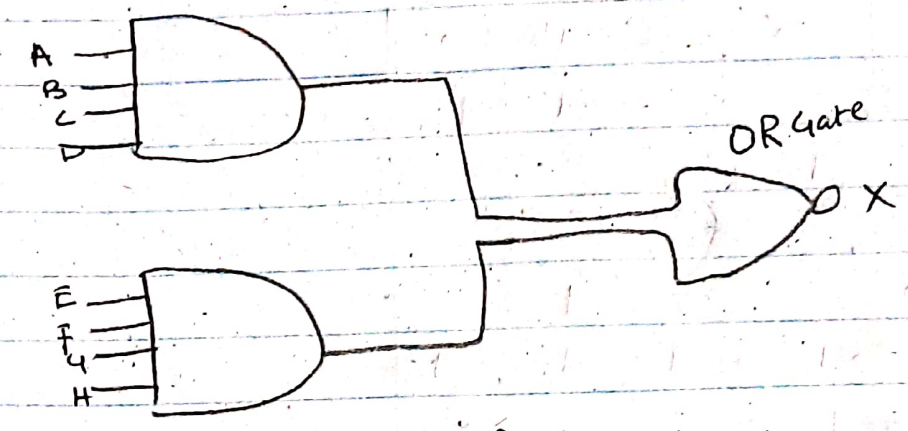
$\overline{(\overline{S+M})+(\overline{\bar{G}+\bar{S}})}$

$\bar{S}\bar{M}+GS$

Diagram:



5)



Boolean Expression:

$$\overline{(ABCD)+(EFGH)}$$

$$(\overline{ABCD})\cdot(\overline{EFGH})$$

$$(\bar{A}+\bar{B}+\bar{C}+\bar{D})\cdot(\bar{E}+\bar{F}+\bar{G}+\bar{H})$$

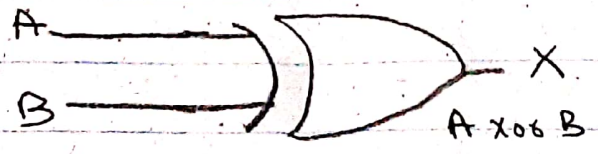
6)

It is XOR Gate:

F Switch	B Switch	X
0	0	0
0	1	1
1	0	1
1	1	0

Equation: (A xor B) OR $(\bar{A}B+A\bar{B})$

Diagram:



7)

Subsituting values from given

Truth table

	00	01	11	10
00			1	1
01	1			
11				
10			1	
	1	1	1	1

Simplified:

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

Diagram.