Saad Bin Khalid – 20K0161

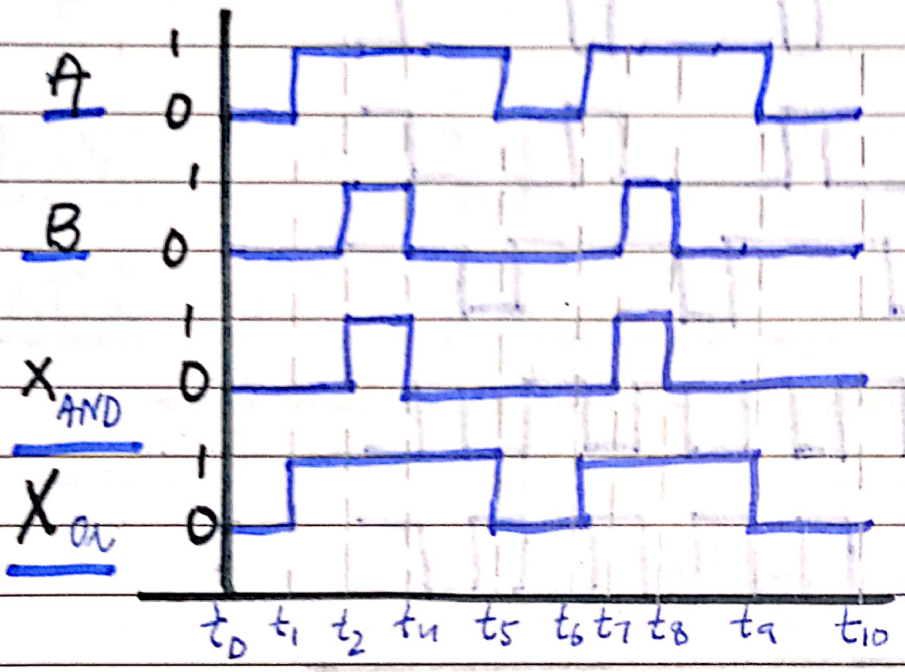
Date: 6-March

ASSIGNMENT 3

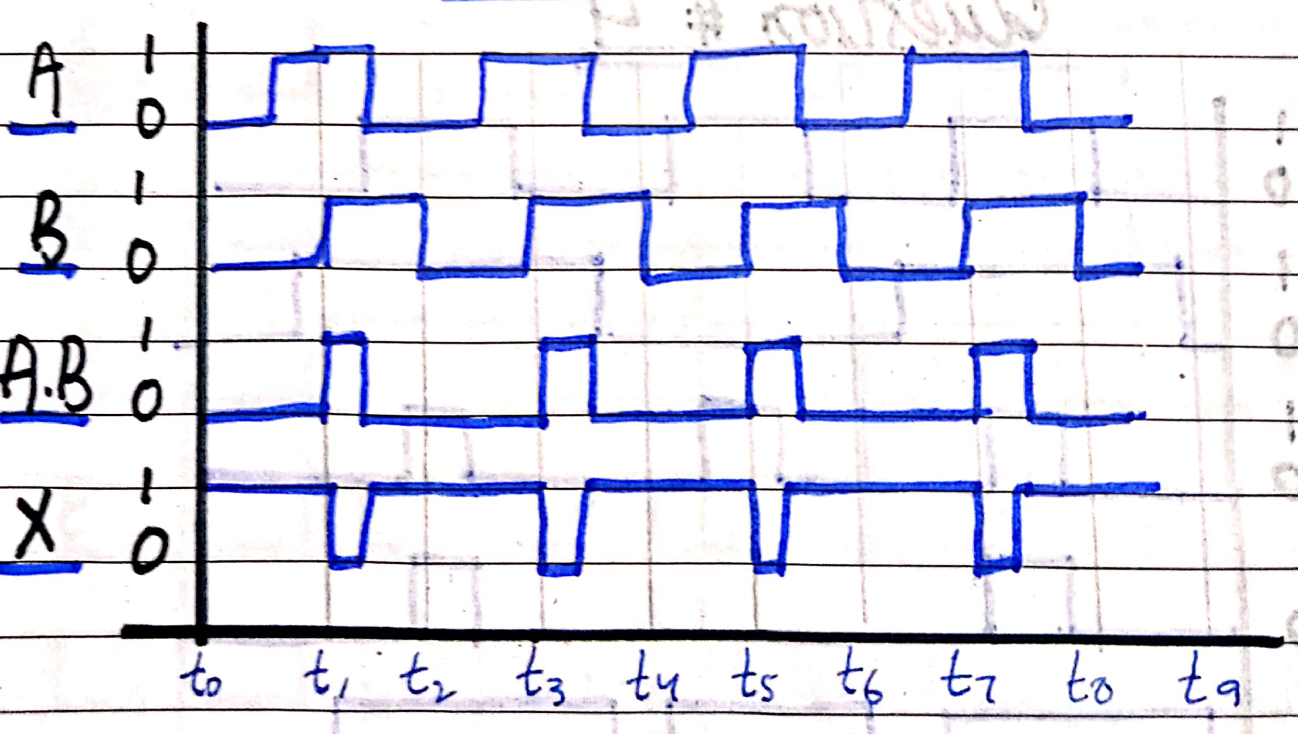
Question # 1

For AND GATE:

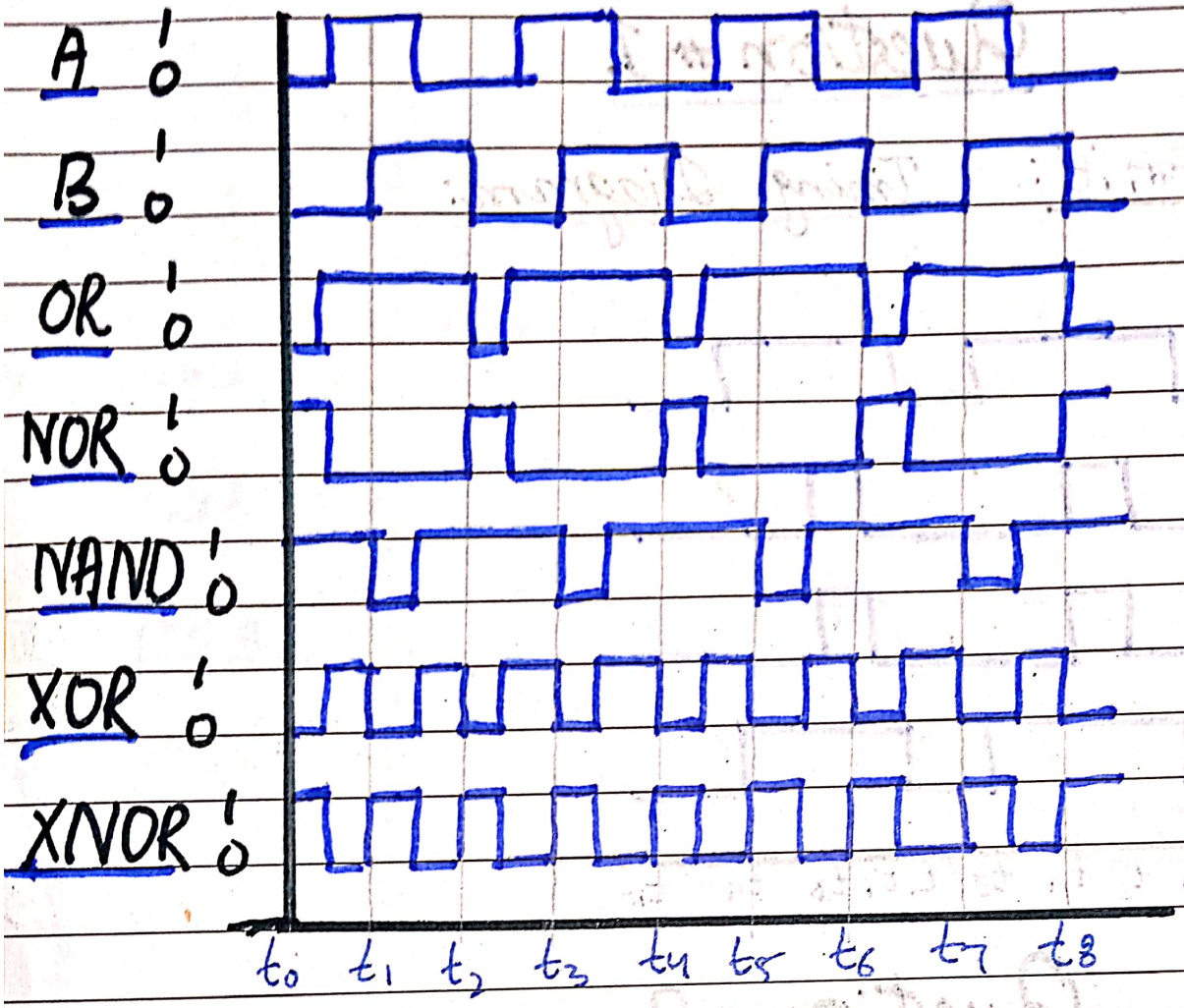
Timing Diagram:



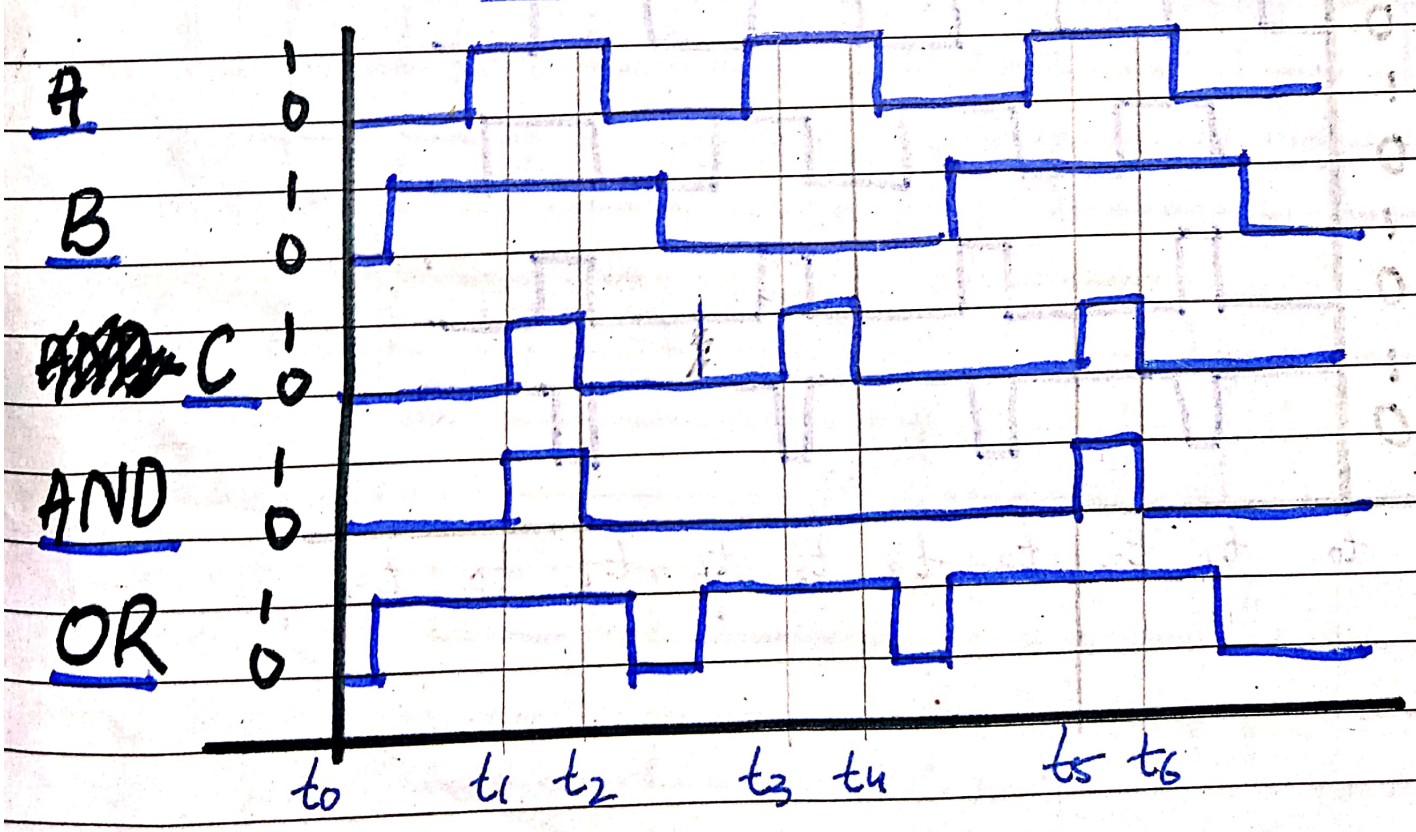
Question # 2



Question # 3

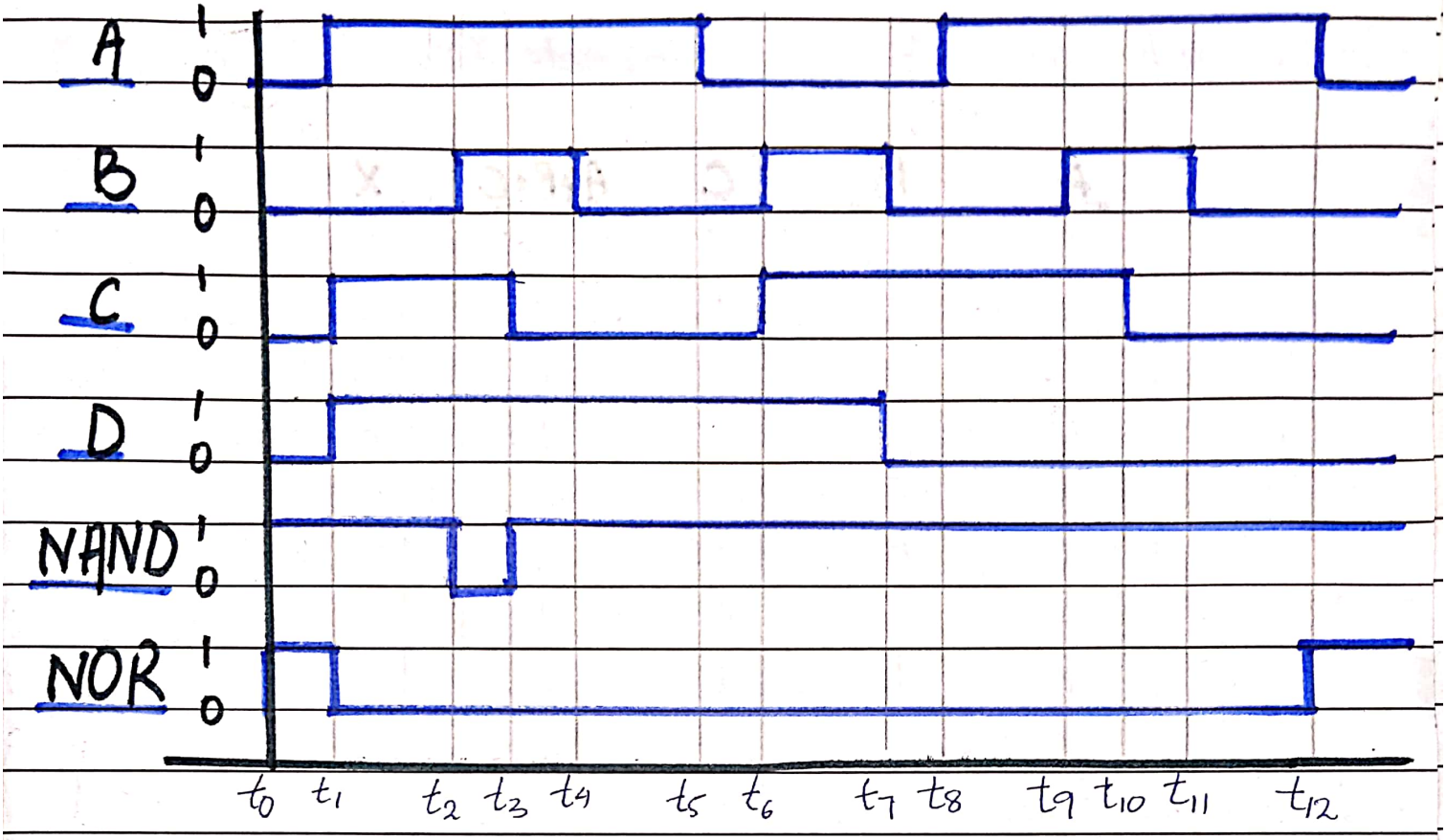


Question # 4

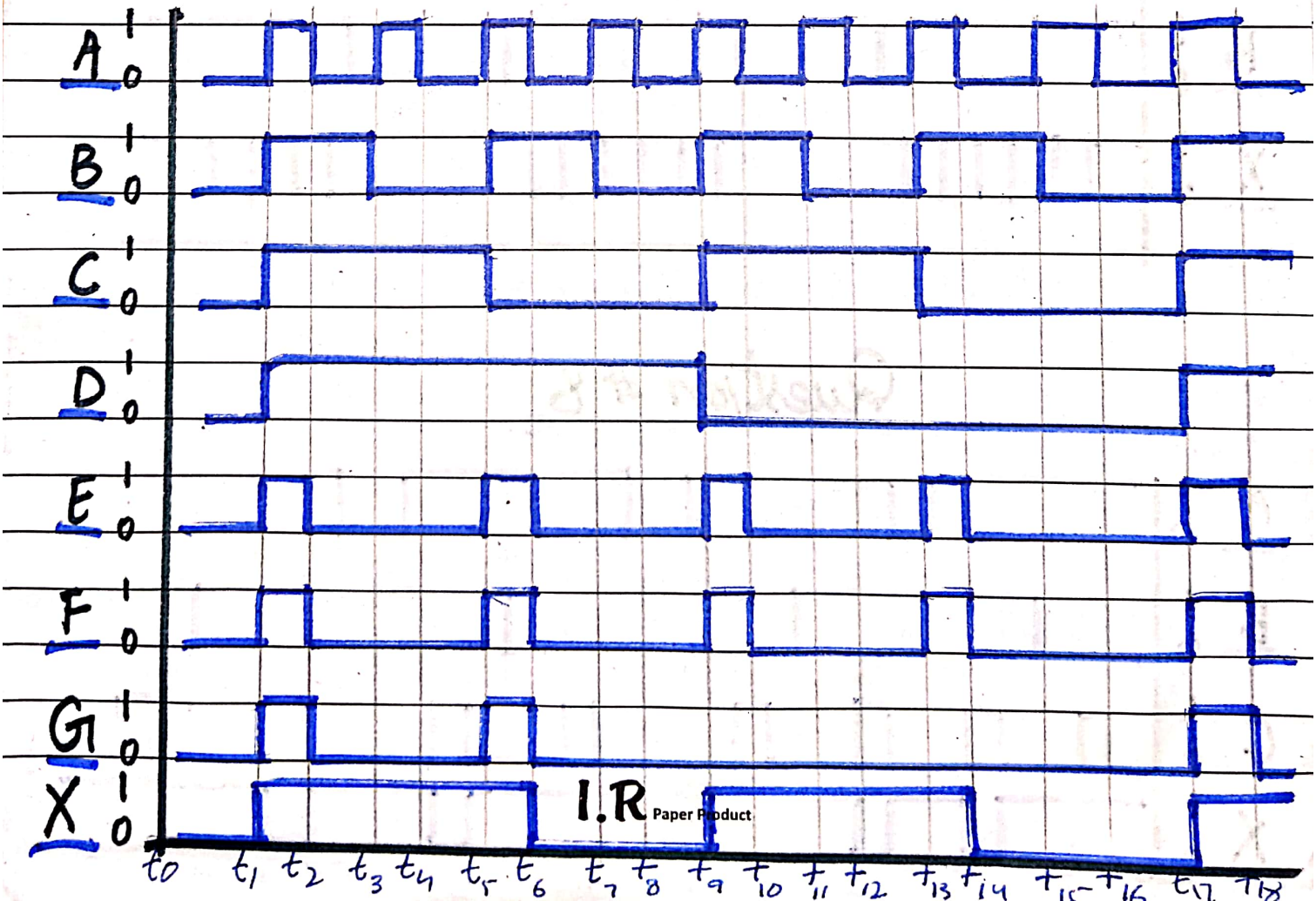


Sandal

Question # 5



Question # 6

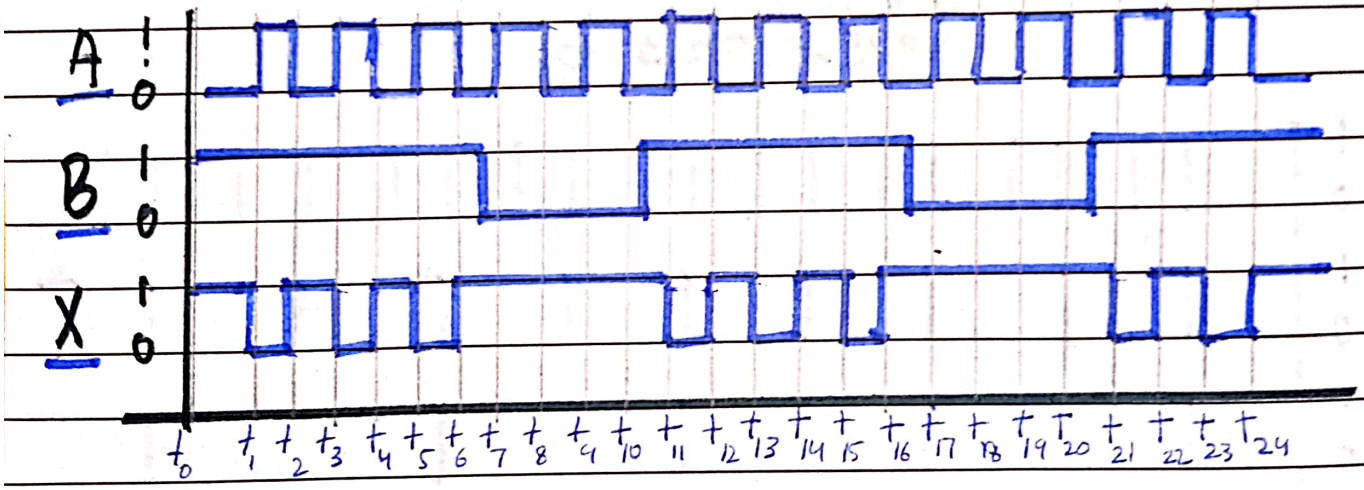


Question # 7

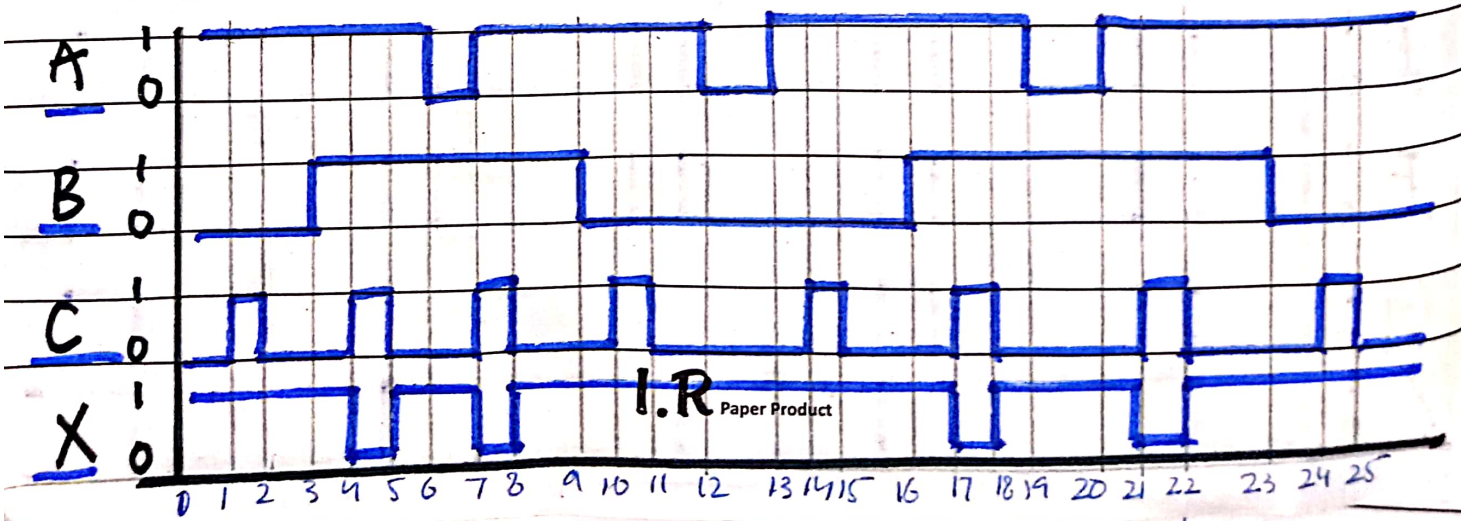
- Truth Table for a 3-Input OR gate followed by an inverter:

A	B	C	A+B+C	X
0	0	0	0	1
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	0

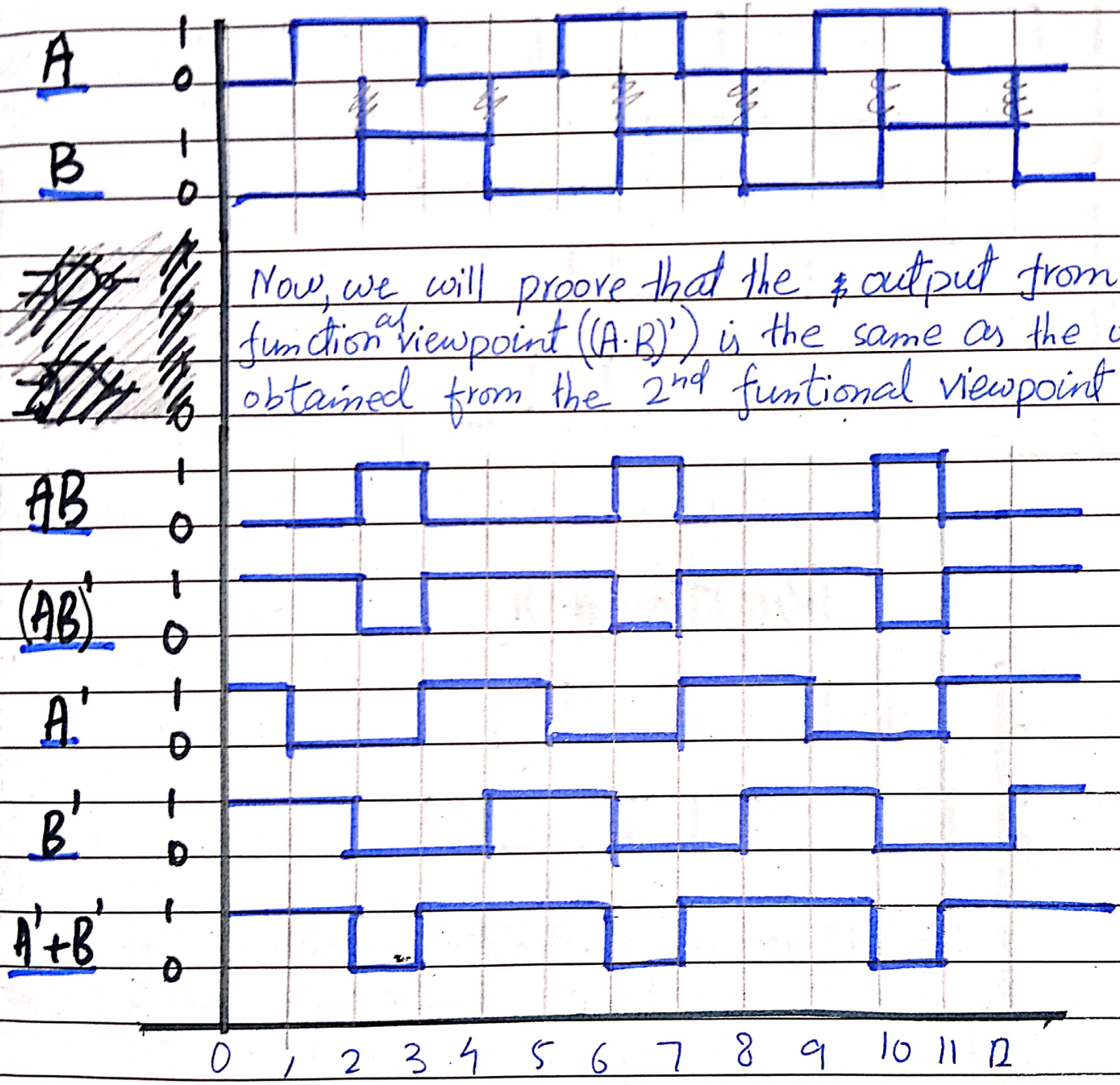
- Timing diagram:



Question # 8



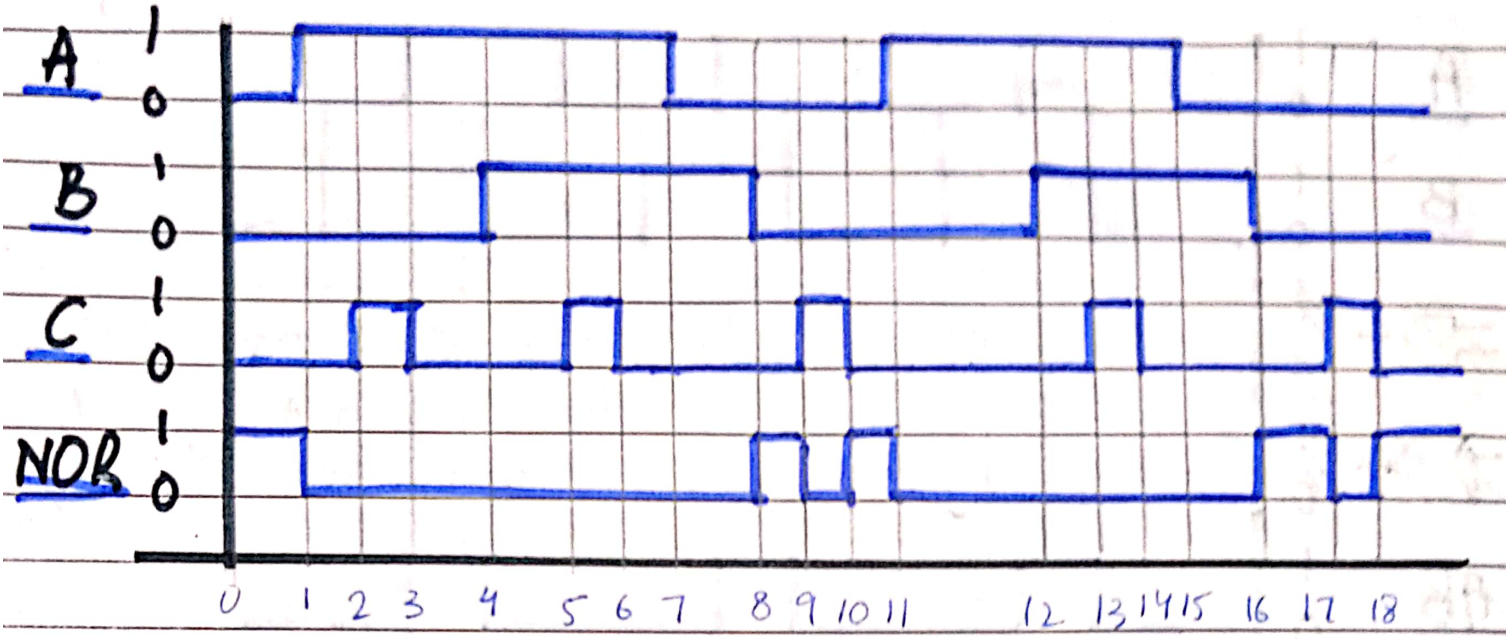
Question # 9



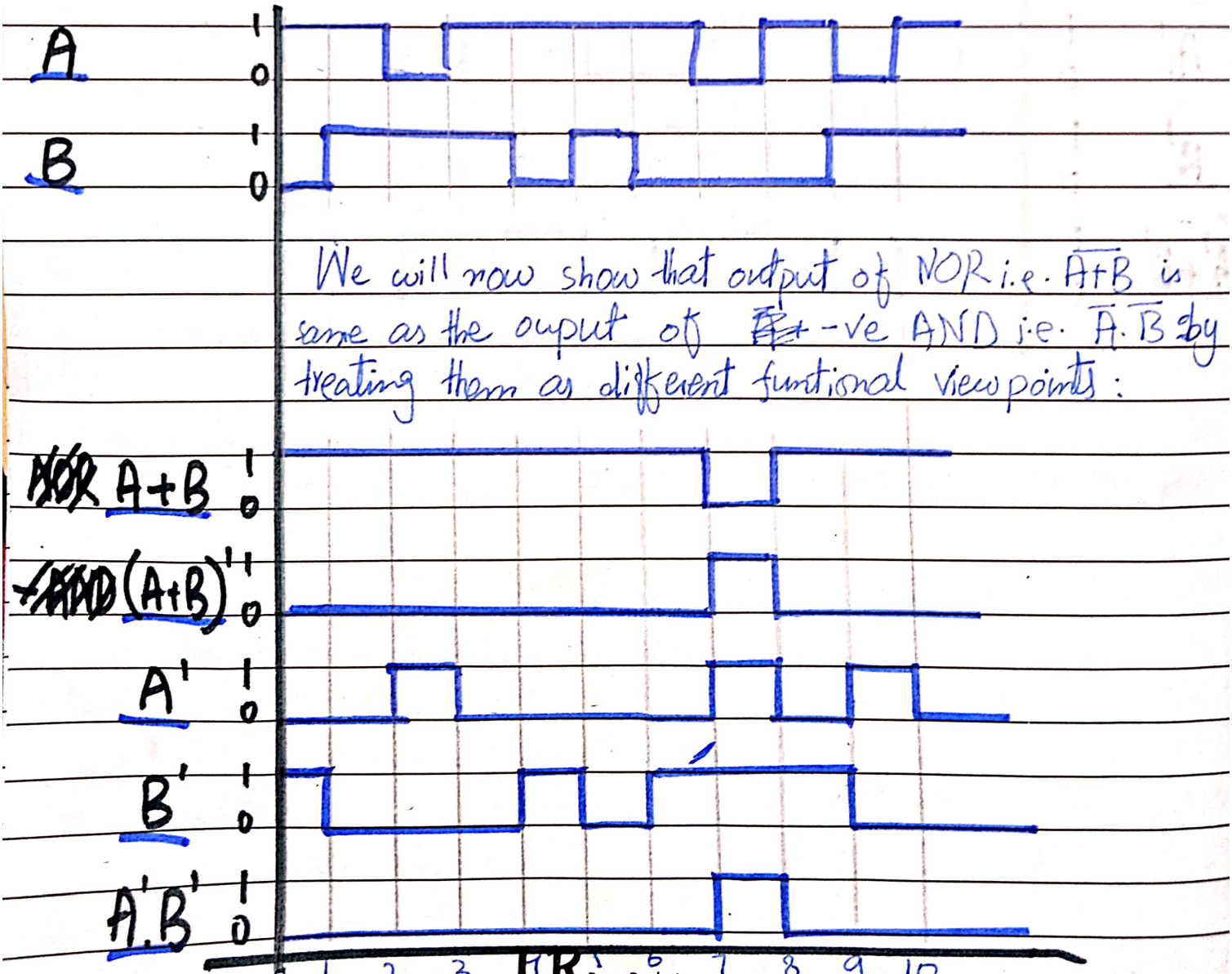
Now, we will proove that the output from 1st function at viewpoint $((A \cdot B)')$ is the same as the output obtained from the 2nd funtional viewpoint $(A' + B')$.

Observe that: $\overline{A \cdot B} = A' + B'$. Hence, prooved

Question # 10



Question # 11



We will now show that output of NOR i.e. $\overline{A+B}$ is same as the ouput of ~~NOR~~ -ve AND i.e. $\overline{A}.\overline{B}$ by treating them as different funtional viewpoints:

Question # 12

Exclusive OR gate (or XOR) produces a high output whenever the number of ~~inputs~~ high inputs is odd; whereas OR gate produces a high output when any input is high, irrespective of even or odd.

Question # 13

a) $\bar{x}\bar{y} + xy + x\bar{y}$:

$\Rightarrow \bar{x}\bar{y} + xy + \bar{x}y$

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

$\Rightarrow \bar{x}\bar{y} + y(1)$

$\Rightarrow y + \bar{x}$

Rules:

- $AB + AC = A(B+C)$
- $A + \bar{A} = 1$
- $A + \bar{A}B = A + B$

b) $(x+y)(x+y')$:

$\Rightarrow x \cdot x + xy' + xy + y \cdot \bar{y}$

$\Rightarrow x + x(y'+y) + 0$

$\Rightarrow x + x(1)$

$\Rightarrow x$

Rules:

- $(A+B)(C+D) = AC + AD + BC + BD$
- $AB + AC = A(B+C)$
- $A + \bar{A} = 1$
- $A + A = A$

c) $\bar{x}y + x\bar{y} + xy + \bar{x}\bar{y}$:

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

$\Rightarrow x(1) + \bar{x}(1)$

$\Rightarrow x + \bar{x}$

$\Rightarrow 1$

Rules:

- $AB + AC = A(B+C)$
- $A + \bar{A} = 1$
- $A.(1) = A$
- $A + \bar{A} = 1$

d) $\bar{x} + xy + x\bar{z} + xyz$:

$\Rightarrow \bar{x} + y + x\bar{z} + xy\bar{z}$

$\Rightarrow \bar{x} + y + x\bar{z}(1 + \bar{y})$

$\Rightarrow \bar{x} + y + x\bar{z}(1)$

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

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

Rules:

- $A + \bar{A}B = A + B$
- $AB + AC = A(B + C)$
- $A + 1 = 1$
- $A.(1) = A$
- $\bar{A} + AB = \bar{A} + B$

Question #14

a) $A'C' + ABC + AC'$:

$\Rightarrow C'(A' + A) + ABC$

$\Rightarrow C'(1) + CAB$

$\Rightarrow C' + CAB$

$\Rightarrow C' + AB$

Rules:

- $AB + AC = A(B + C)$
- $A + \bar{A} = 1$
- $A.(1) = A$
- $\bar{A} + AB = \bar{A} + B$

b) $(x'y' + z)' + z + xy + wz$:

$\Rightarrow (x'y' + z)' + xy + z(1 + w)$

$\Rightarrow (x'y' + z)' + xy + z$

$\Rightarrow (x'y')' \cdot z' + xy + z$

$\Rightarrow z + (x'y')' + xy$

$\Rightarrow z + (x')' + (y')' + xy$

$\Rightarrow z + x + y + xy$

$\Rightarrow z + x(1 + y) + y$

$\Rightarrow z + x(1) + y$

$\Rightarrow x + y + z$

Rules:

- $AB + AC = A.(B + C)$
- $1 + A = 1$
- $\overline{A + B} = \bar{A} \cdot \bar{B}$
- $A + \bar{A}B = A + B$
- $\overline{A.B} = A' + B'$
- $\bar{\bar{A}} = A$
- $A + AB = A(1 + B)$
- $1 + A = 1$
- $A.(1) = A$

Date:

c) $A'B(D'+C'D)+B(A+A'CD)$:

$\Rightarrow A'B(D'+DC')+B(A+A'CD)$

$\Rightarrow A'B(D'+C')+B(A+CD)$

$\Rightarrow B.(A'D'+A'C'+A+CD)$

$\Rightarrow B(A+C'+A'D'+CD)$

$\Rightarrow B(A+C'+A'D'+D)$

$\Rightarrow B(A+C'+D+A')$

$\Rightarrow B(1)$

$\Rightarrow B$

Rules:

- $AB = BA$
- $A+\bar{A}B = A+B$
- $AB+AC = A(B+C)$
- $A+\bar{A}B = A+B$
- $A+\bar{A}B = A+B$
- $A+\bar{A}B = A+B$
- $A+\bar{A} = 1$
- $A(1) = A$

d) $(A'+C)(A'+C')(A+B+C'D)$:

$\Rightarrow (A'.A'+A'C'+CA'+CC')(A+B+C'D)$

$\Rightarrow (A'+A'C'+CA'+CC')(A+B+C'D)$

$\Rightarrow \{[A'(1+C')+C(A'+C')](A+B+C'D)$

$\Rightarrow (A'.1+A'C+CC')(A+B+C'D)$

$\Rightarrow [A'(1+C)+CC')(A+B+C'D)$

$\Rightarrow (A'+CC')(A+B+C'D)$

$\Rightarrow (A'+0)(A+B+C'D)$

$\Rightarrow A'.(A+B+C'D)$

$\Rightarrow A'A+A'(B+C'D)$

$\Rightarrow 0+A'(B+C'D)$

$\Rightarrow A'(B+C'D)$

Rules:

1) Distributive law
2) $A.A = A$
3) same as (1).
4) $A+1 = 1$
5) same as (1)
6) same as (4)
7) $A\bar{A} = 0$
8) $A+0 = A$
9) same as (1)
10) same as (7)
11) same as (8)

Question #15

a) $\overline{\bar{A}BC}$:

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

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

Rules:

1) $\overline{xyz} = \bar{x}+\bar{y}+\bar{z}$
2) $\bar{\bar{x}} = x$

Date:

b) $\overline{A + BC}$:

$\Rightarrow \overline{A} \cdot \overline{BC}$

$\Rightarrow A \cdot \overline{\overline{B}C}$

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

$\Rightarrow A(B + \overline{C})$

Rules:

1) $\overline{x+y} = \overline{x} \cdot \overline{y}$
2) $\overline{\overline{x}} = x$
3) $\overline{xy} = \overline{x} + \overline{y}$
4) same as (2)

c) $\overline{ABCD}$:

$\Rightarrow \overline{A} + \overline{B} + \overline{CD}$

$\Rightarrow \overline{A} + \overline{B} + CD$

Rules:

1) $\overline{xyz} = \overline{x} + \overline{y} + \overline{z}$
2) $\overline{\overline{x}} = x$

d) $\overline{A + B}$:

$\Rightarrow \overline{A} \cdot \overline{B}$

$\Rightarrow \overline{A} \cdot B$

Rules:

1) $\overline{x+y} = \overline{x} + \overline{y}$
2) $\overline{\overline{x}} = x$

e) $\overline{\overline{AB}}$:

$\Rightarrow \overline{A} + \overline{B}$

$\Rightarrow \overline{\overline{A}} \cdot \overline{B}$

$\Rightarrow AB$

Rules:

1) $\overline{xy} = \overline{x} + \overline{y}$
2) $\overline{x+y} = \overline{x} \cdot \overline{y}$
3) $\overline{\overline{x}} = x$

f) $\overline{\overline{A} + \overline{C} + \overline{D}}$:

$\Rightarrow \overline{\overline{A}} \cdot \overline{\overline{C}} \cdot \overline{D}$

$\Rightarrow ACD$

Rules:

1) $\overline{x+y+z} = \overline{x}\,\overline{y}\,\overline{z}$
2) $\overline{\overline{x}} = x$

g) $\overline{A(B+C)D}$:

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

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

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

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

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

Rules:

1) $\overline{xyz} = \overline{x} + \overline{y} + \overline{z}$
2) $\overline{x+y} = \overline{x} \cdot \overline{y}$
3) $\overline{\overline{x}} = x$
4) $\overline{xy} = \overline{x} + \overline{y}$
5) same as (3)

h) $\overline{(M+\overline{N})(\overline{M}+N)}$:

$\Rightarrow \overline{M+\overline{N}} + \overline{\overline{M}+N}$

$\Rightarrow \overline{M} \cdot \overline{\overline{N}} + \overline{\overline{M}} \cdot \overline{N}$

$\Rightarrow \overline{M} \cdot N + M \cdot \overline{N}$ OR:

$\Rightarrow \overline{\overline{MN}} + \overline{M\overline{N}}$

$\rightarrow \overline{\overline{M}+\overline{N}} + \overline{M+\overline{N}}$

$\rightarrow \overline{M+\overline{N}} + \overline{M+N}$

Rules:

1) $\overline{xy} = \overline{x} + \overline{y}$
2) $\overline{x+y} = \overline{x} \cdot \overline{y}$
3) $\overline{\overline{x}} = x$
4) $x = \overline{\overline{x}}$
5) same as (1)
6) same as (3)

i) $\overline{\overline{ABCD}}$:

$\Rightarrow \overline{\overline{ABC}} + \overline{D}$

$\Rightarrow \overline{ABC} + \overline{D}$

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

Rules:

1) $\overline{xy} = \overline{x} + \overline{y}$
2) $\overline{\overline{x}} = x$
3) same as (1)