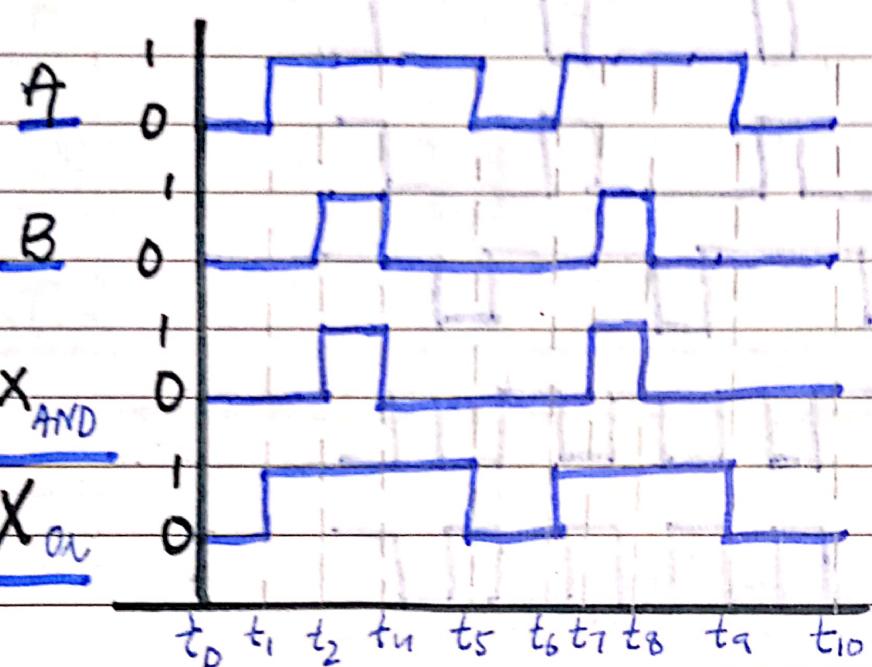
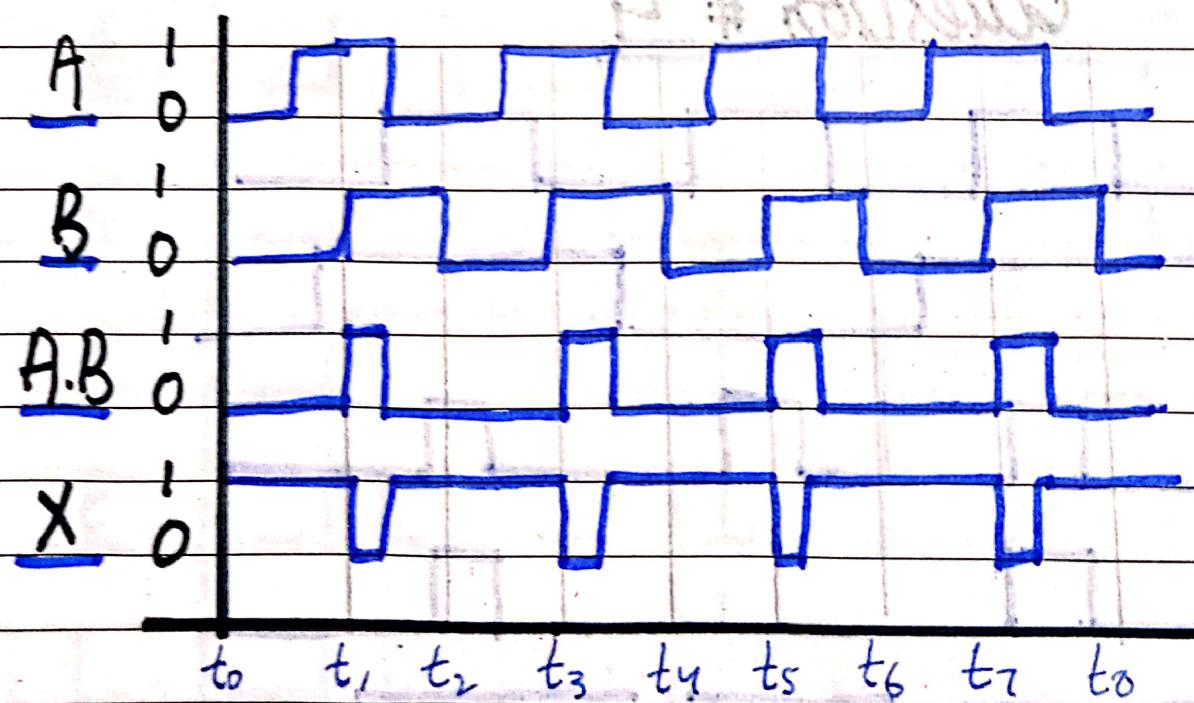
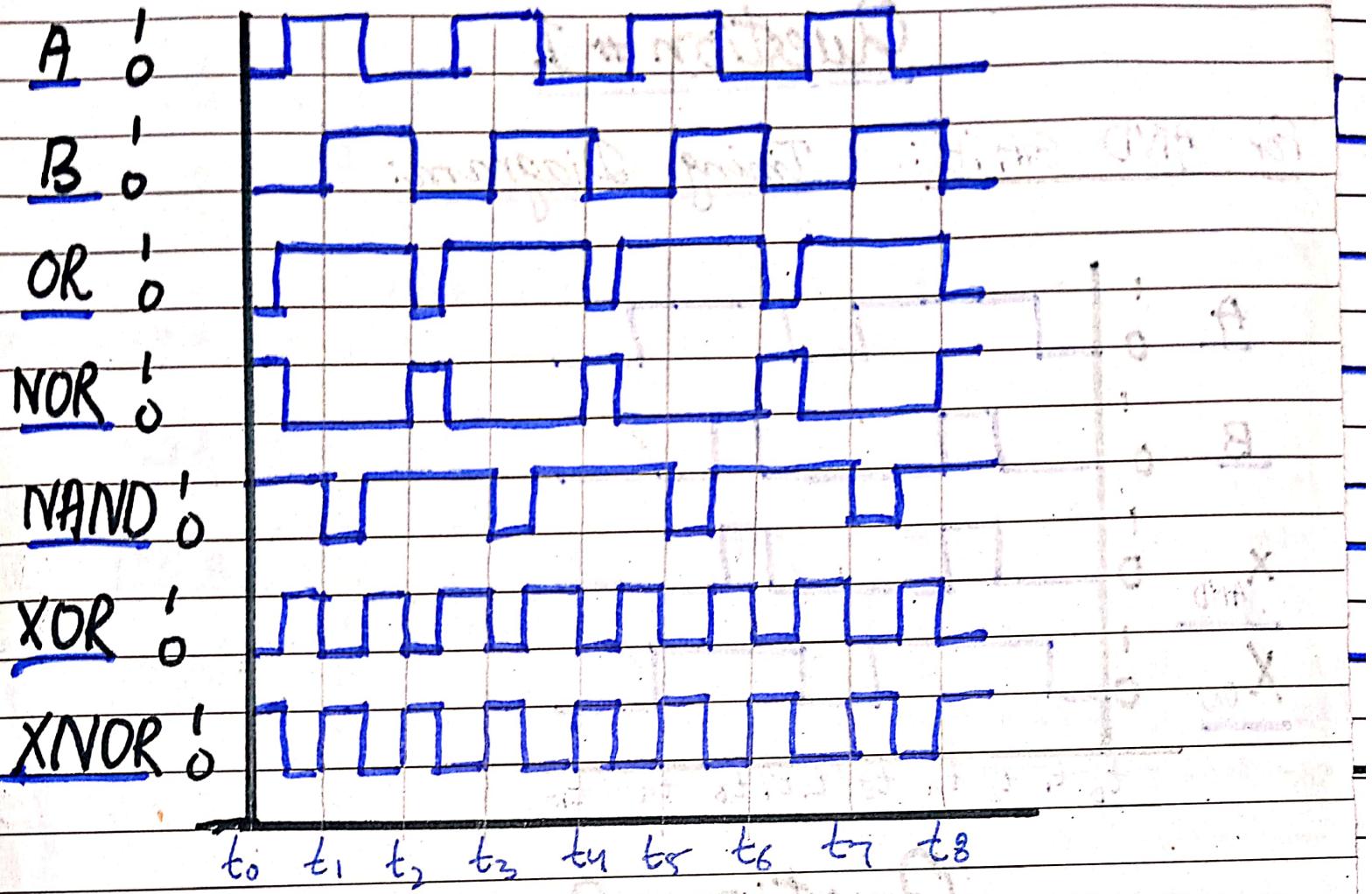


ASSIGNMENT 3Question # 1

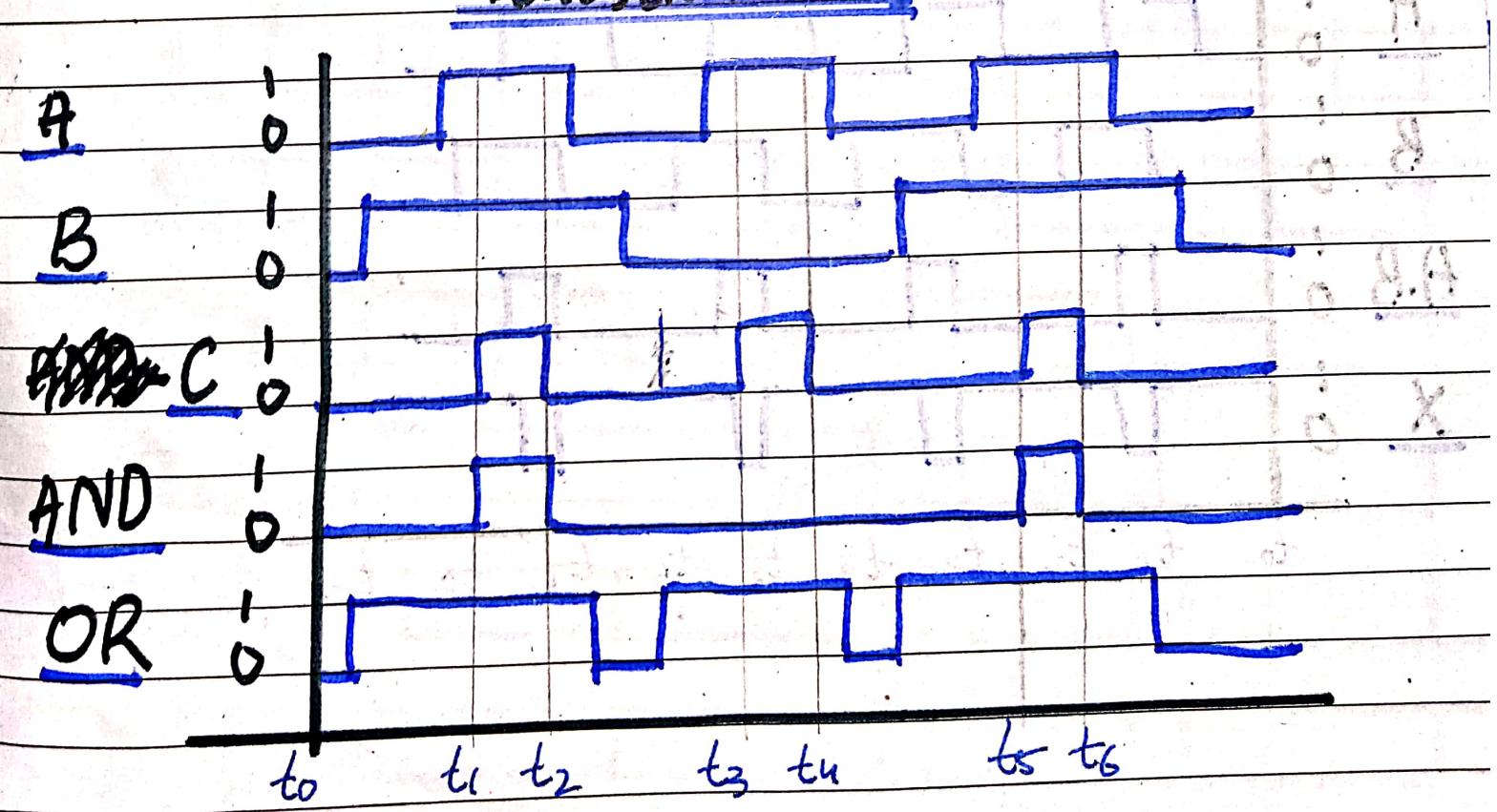
For AND GATE: Timing Diagram:

Question # 2

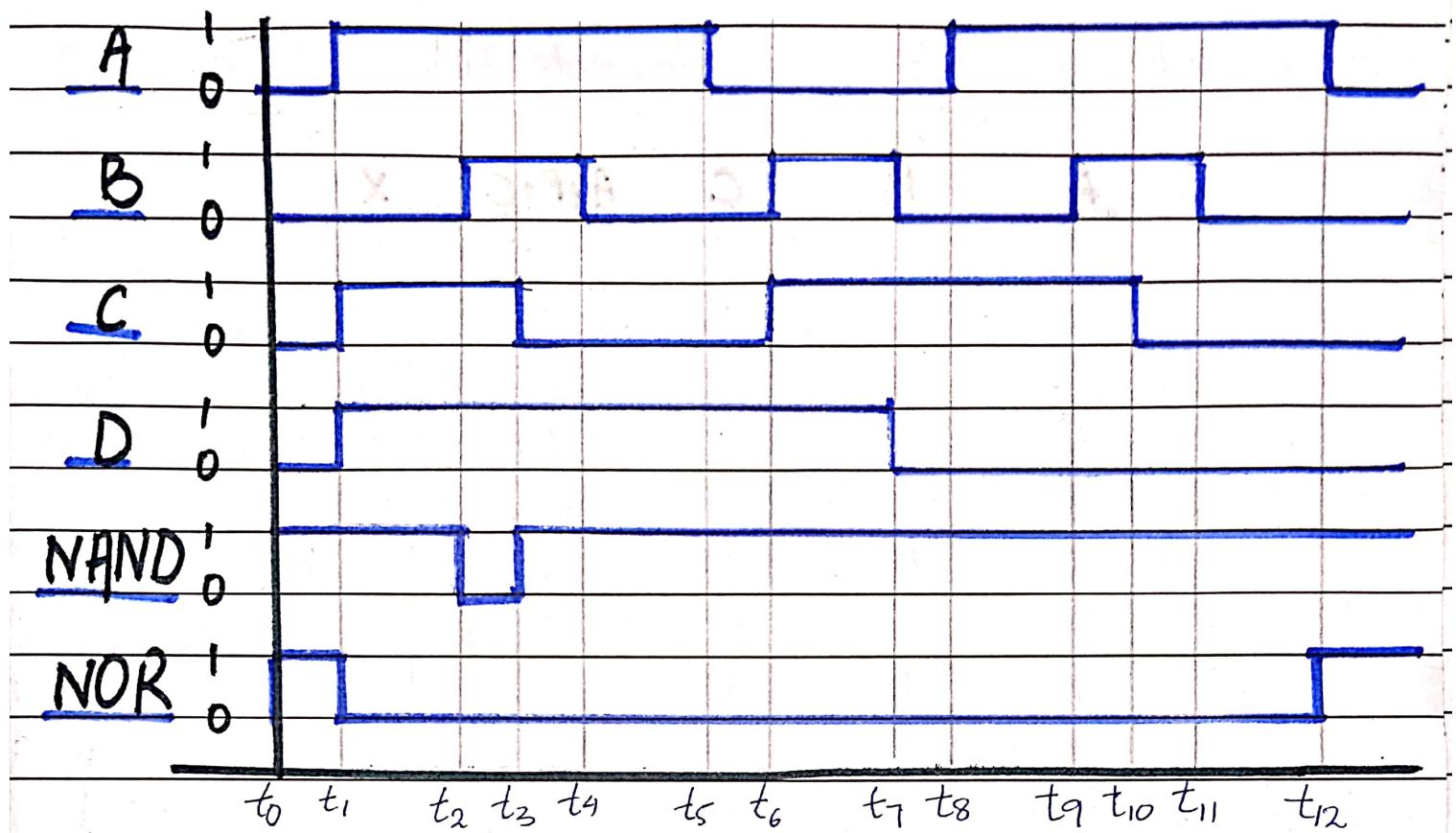
Question # 3



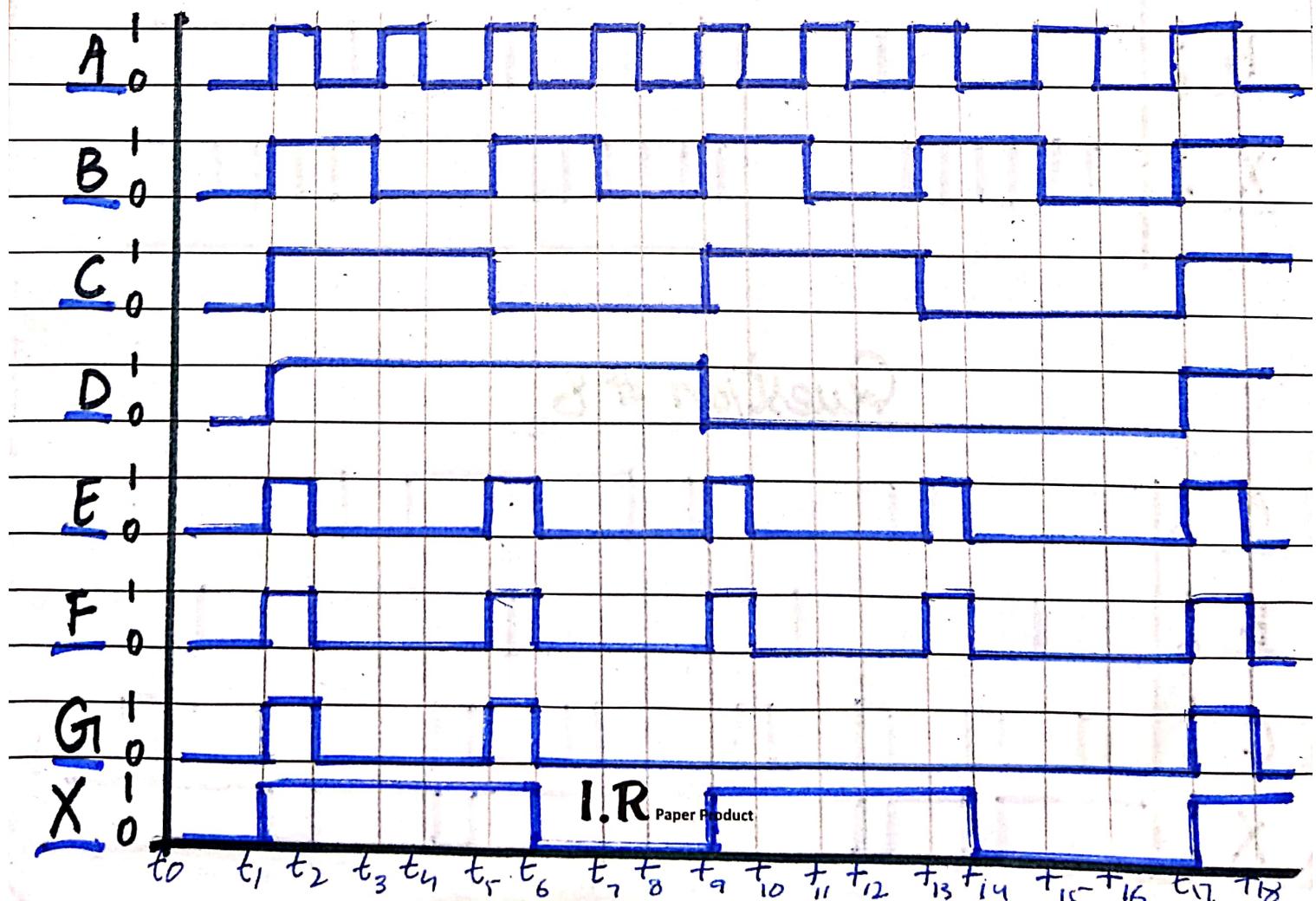
Question # 4



Question #5



Question # 6

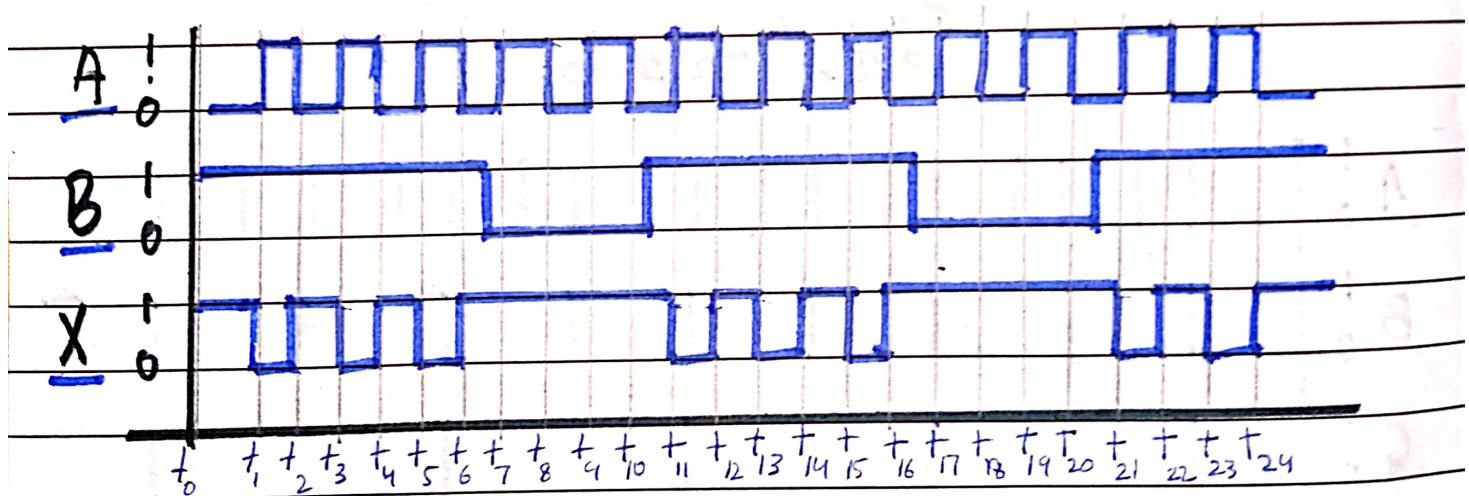


Question # 7

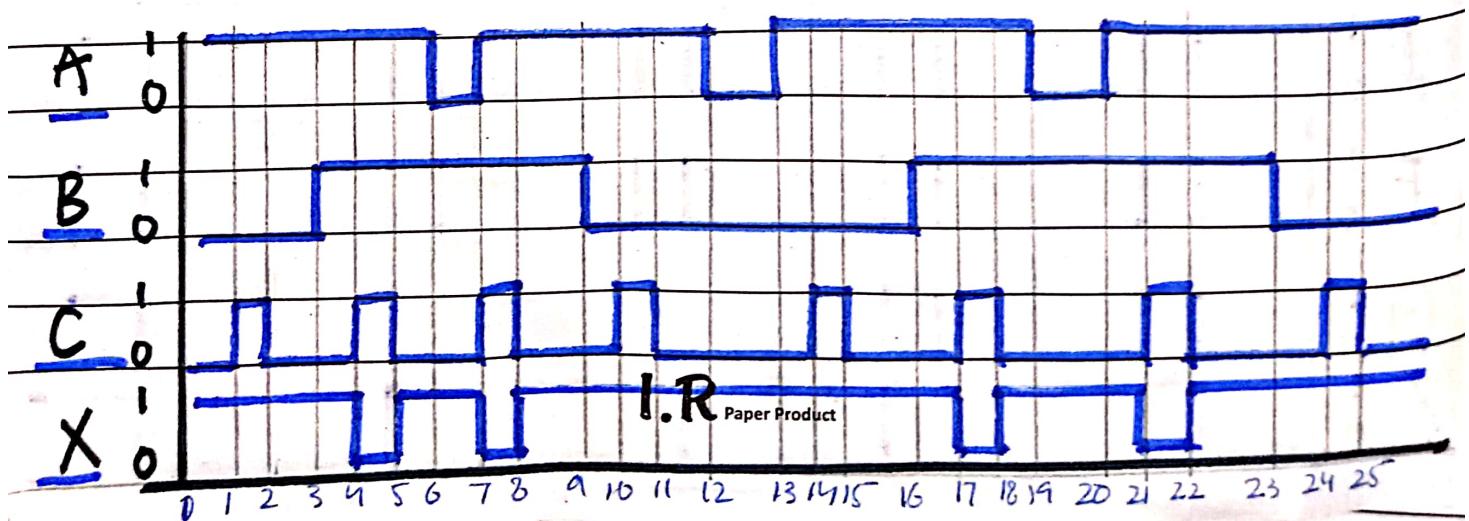
- Truth Table for a 3-Input OR gate followed by an inverter:

	<u>A</u>	<u>B</u>	<u>C</u>	<u>A+B+C</u>	<u>X</u>
	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

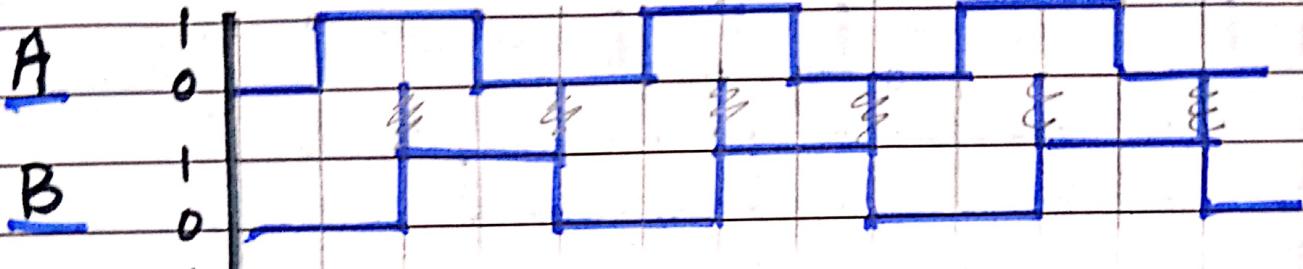
- Timing diagram :



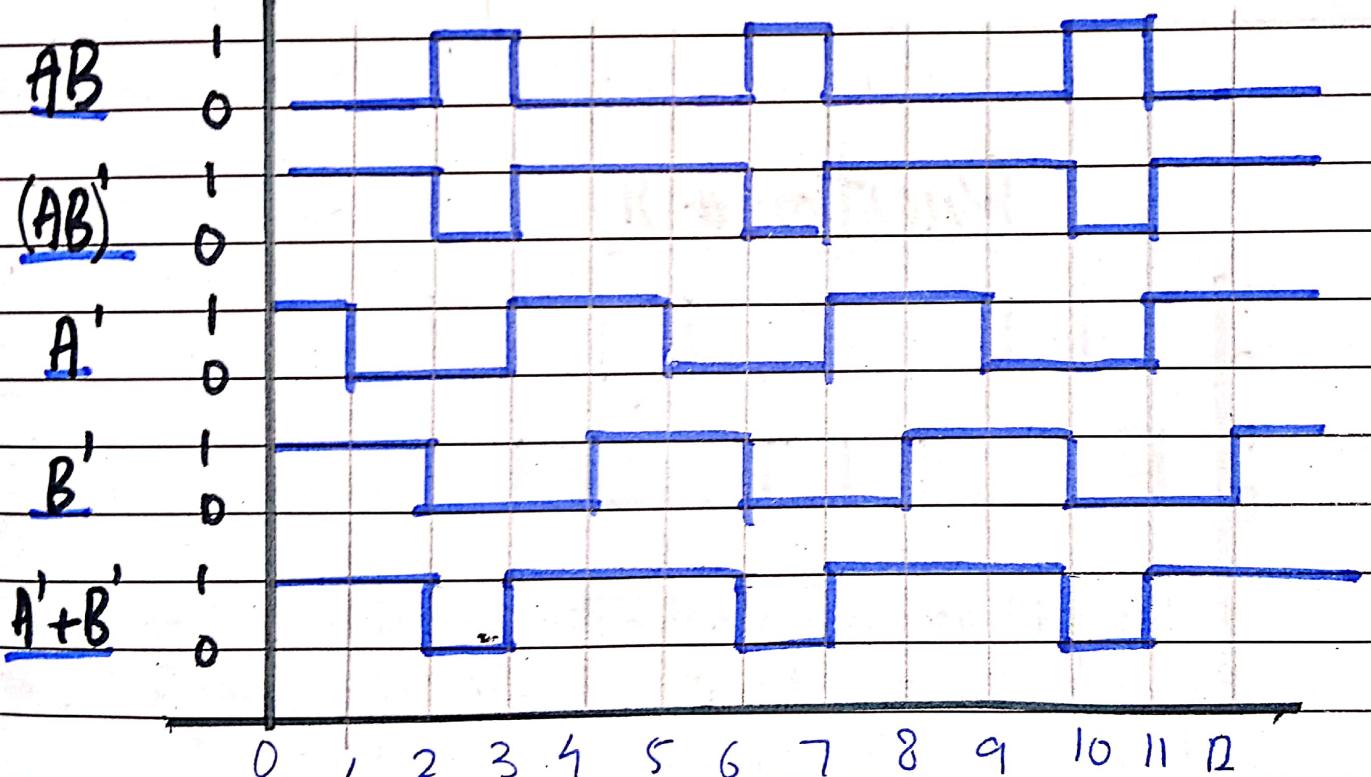
Question # 8



Question # 9

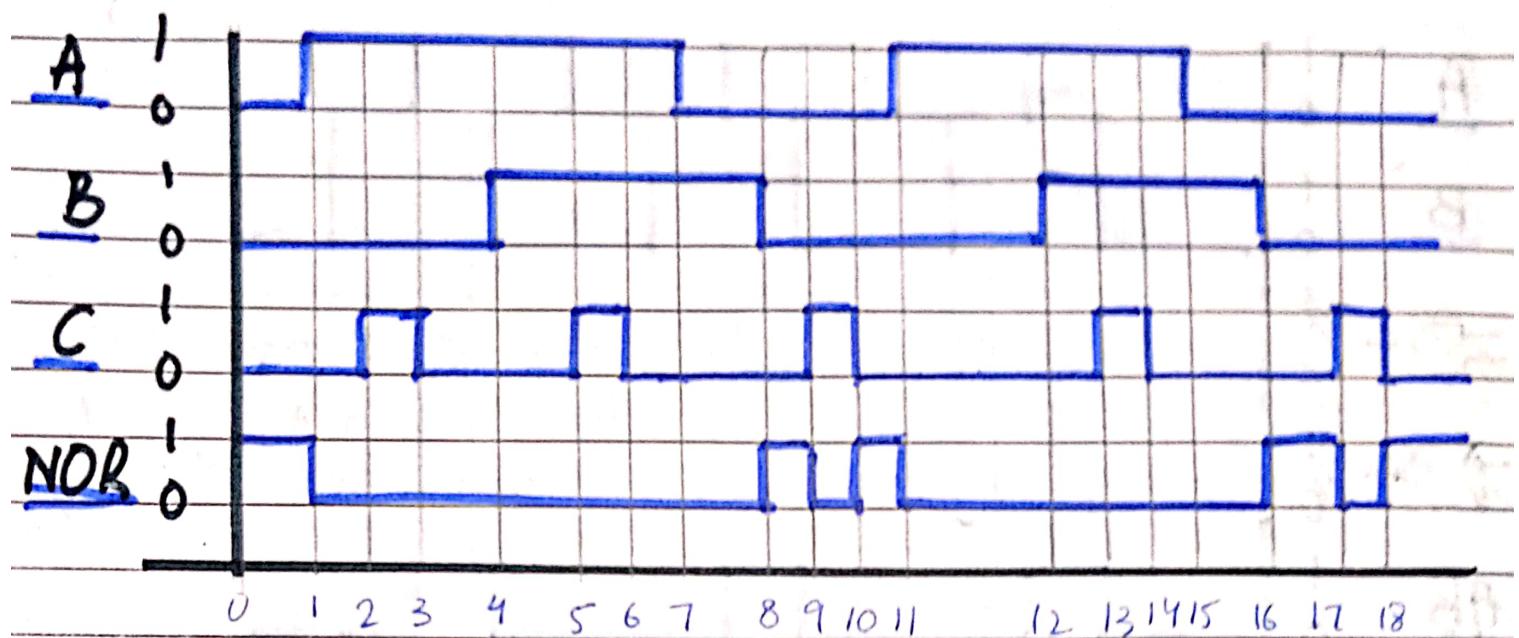


~~AB~~ Now, we will prove that the output from 1st function viewpoint $(A \cdot B)'$ is the same as the output obtained from the 2nd functional viewpoint $(A' + B')'$.

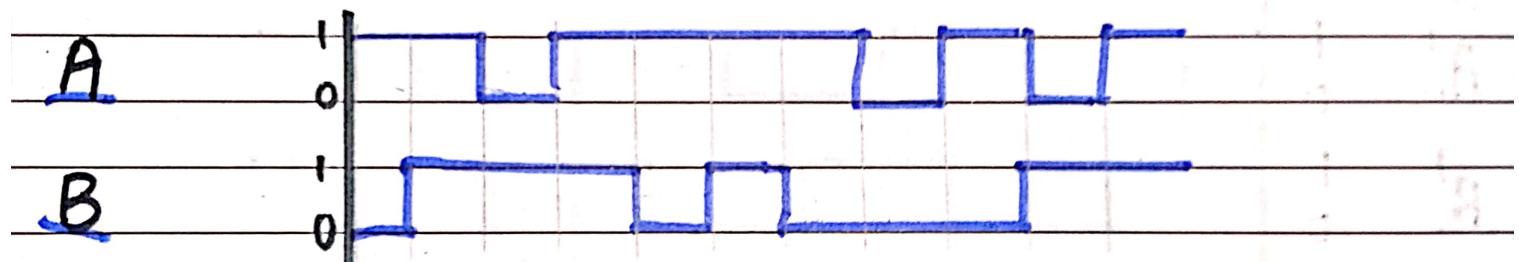


Observe that: $\overline{AB} = A' + B'$. Hence, proved

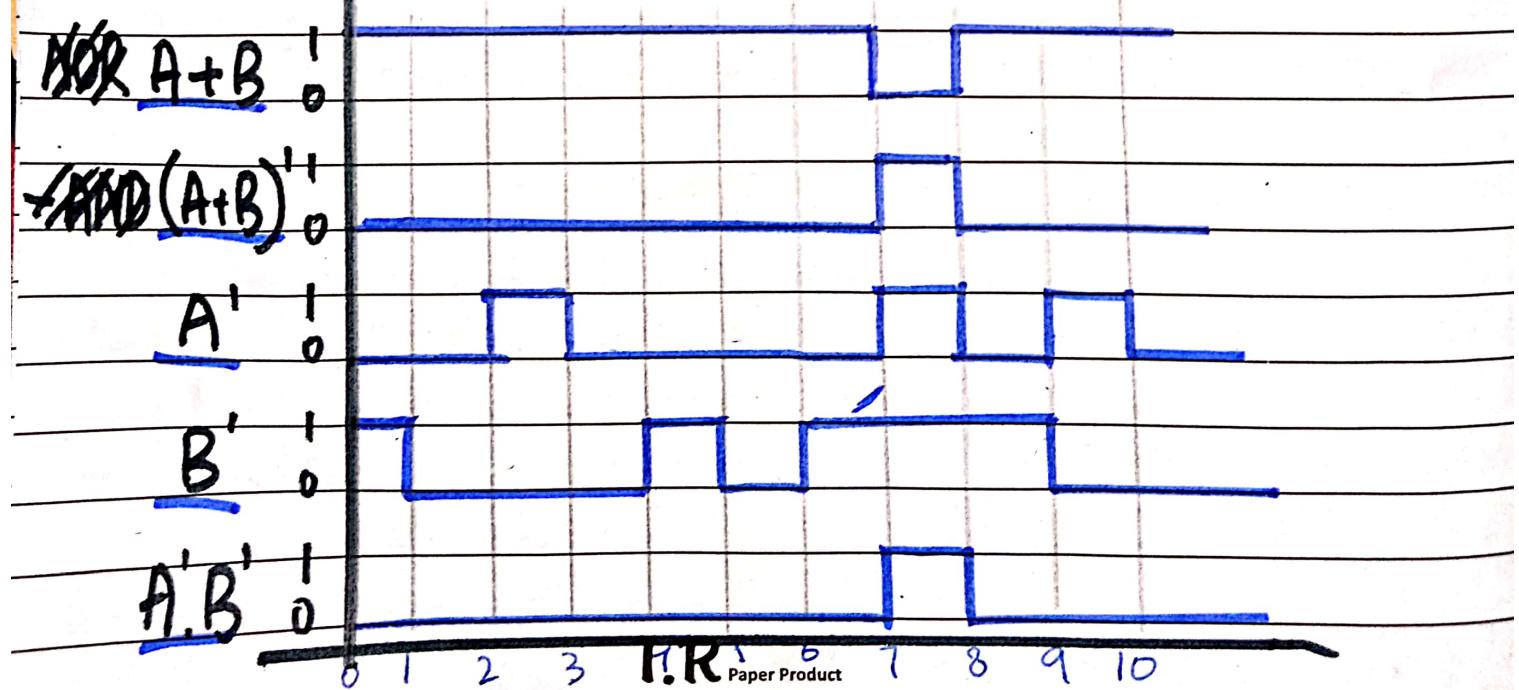
Question # 10



Question # 11



We will now show that output of NOR i.e. $\overline{A+B}$ is same as the output of ~~NOT~~-ve AND i.e. $\overline{A} \cdot \overline{B}$ by treating them as different functional viewpoints:



Question #12

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

Question #13

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

$$\begin{aligned} &\Rightarrow \bar{x}\bar{y} + xy + \bar{x}y \\ &\Rightarrow \bar{x}\bar{y} + y(x + \bar{x}) \\ &\Rightarrow \bar{x}\bar{y} + y(1) \\ &\Rightarrow y + \bar{x} \end{aligned}$$

Rules:

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

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

$$\begin{aligned} &\Rightarrow x \cdot x + xy' + xy + y \cdot \bar{y} \\ &\Rightarrow x + x(y' + y) + 0 \\ &\Rightarrow x + x(1) \\ &\Rightarrow x \end{aligned}$$

Rules:

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

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

$$\begin{aligned} &\Rightarrow x(\bar{y} + y) + \bar{x}(y + \bar{y}) \\ &\Rightarrow x(1) + \bar{x}(1) \\ &\Rightarrow x + \bar{x} \\ &\Rightarrow 1 \end{aligned}$$

Rules:

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

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

$$\begin{aligned}&\Rightarrow \bar{x} + y + x\bar{z} + x\bar{y}\bar{z} \\&\Rightarrow \bar{x} + y + x\bar{z}(1 + \bar{y}) \\&\Rightarrow \bar{x} + y + x\bar{z}(1) \\&\Rightarrow \bar{x} + x\bar{z} + y \\&\Rightarrow \bar{x} + \bar{z} + y\end{aligned}$$

Rules:

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

Question #14

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

$$\begin{aligned}&\Rightarrow C'(A' + A) + ABC \\&\Rightarrow C'(1) + CAB \\&\Rightarrow C' + CAB \\&\Rightarrow C' + AB\end{aligned}$$

Rules:

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

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

$$\begin{aligned}&\Rightarrow (x'y' + z)' + xy + z(1 + w) \\&\Rightarrow (x'y' + z)' + xy + z \\&\Rightarrow (x'y')' \cdot z' + xy + z\end{aligned}$$

Rules:

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

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

$$\begin{aligned}
 &\Rightarrow A'B(D' + DC') + B(A + A'CD) \\
 &\Rightarrow A'B(D' + C') + B(A + CD) \\
 &\Rightarrow B(A'D' + A'C' + A + CD) \\
 &\Rightarrow B(A + C' + A'D' + CD) \\
 &\Rightarrow B(A + C' + A'D' + D) \\
 &\Rightarrow B(A + C' + D + A') \\
 &\Rightarrow B(1) \\
 &\Rightarrow B
 \end{aligned}$$

Rules:

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

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

$$\begin{aligned}
 &\Rightarrow (A'A' + A'C' + CA' + CC')(A + B + C'D) \\
 &\Rightarrow (A' + A'C' + CA' + CC')(A + B + C'D) \\
 &\Rightarrow [(A'(1+C') + C(A'+C'))](A + B + C'D) \\
 &\Rightarrow [A'(1+C) + CC'](A + B + C'D) \\
 &\Rightarrow [A'(1+C) + CC'](A + B + C'D) \\
 &\Rightarrow (A' + CC')(A + B + C'D) \\
 &\Rightarrow (A' + 0)(A + B + C'D) \\
 &\Rightarrow A'(A + B + C'D) \\
 &\Rightarrow A'A + A'(B + C'D) \\
 &\Rightarrow 0 + A'(B + C'D) \\
 &\Rightarrow A'(B + C'D)
 \end{aligned}$$

- 1) Distributive law
- 2) $A \cdot A = A$
- 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{ABC} :

$$\begin{aligned}
 &\Rightarrow \overline{A} + \overline{B} + \overline{C} \\
 &\Rightarrow A + \overline{B} + C
 \end{aligned}$$

Rules:

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

b) $\bar{A} + \bar{B}\bar{C}$:

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

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

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

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

Rules:

$$1) \bar{x} + y = \bar{x} \cdot \bar{y}$$

$$2) \bar{\bar{x}} = x$$

$$3) \bar{xy} = \bar{x} + \bar{y}$$

4) same as (2)

c) $\bar{A}\bar{B}\bar{C}\bar{D}$:

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

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

Rules:

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

$$2) \bar{\bar{x}} = x$$

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

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

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

Rules:

$$1) \bar{x} + \bar{y} = \bar{x} + \bar{y}$$

$$2) \bar{\bar{x}} = x$$

e) $\bar{A}\bar{B}$:

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

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

$$\Rightarrow AB$$

Rules:

$$1) \bar{xy} = \bar{x} + \bar{y}$$

$$2) \bar{x+y} = \bar{x} \cdot \bar{y}$$

$$3) \bar{\bar{x}} = x$$

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

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

$$\Rightarrow ACD$$

Rules:

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

$$2) \bar{\bar{x}} = x$$

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

$$\begin{aligned}\Rightarrow & \bar{A} + (\overline{\bar{B} + \bar{C}}) + \bar{D} \\ \Rightarrow & \bar{A} + \overline{\bar{B} \cdot \bar{C}} + \bar{D} \\ \Rightarrow & \bar{A} + \overline{\bar{B} \cdot C} + \bar{D} \\ \Rightarrow & \bar{A} + \overline{\bar{B} \cdot \bar{C}} + \bar{D} \\ \Rightarrow & \bar{A} + B + \bar{C} + \bar{D}\end{aligned}$$

Rules:

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

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

$$\begin{aligned}\Rightarrow & \overline{M+N} + \overline{\bar{M}+N} \\ \Rightarrow & \overline{\bar{M} \cdot N} + \overline{\bar{M} \cdot \bar{N}} \\ \Rightarrow & \overline{M \cdot N} + \overline{M \cdot \bar{N}} \quad \text{OR:} \\ \Rightarrow & \overline{\overline{MN}} + \overline{\overline{M\bar{N}}} \\ \Rightarrow & \overline{\overline{M+N}} + \overline{\overline{M+\bar{N}}} \\ \Rightarrow & \overline{M+N} + \overline{M+\bar{N}}\end{aligned}$$

Rules:

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

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

$$\begin{aligned}\Rightarrow & \overline{\overline{ABC}} + \overline{D} \\ \Rightarrow & \overline{\overline{ABC}} + \bar{D} \\ \Rightarrow & (\bar{A} + \bar{B})C + \bar{D}\end{aligned}$$

Rules:

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