

$$\begin{aligned}\bar{A} &\Rightarrow \text{NOT } A \\ A \cdot B &\Rightarrow A \text{ AND } B \\ A + B &\Rightarrow A \text{ OR } B\end{aligned}$$

Laws:

1. Commutative: $A+B = B+A$, $A \cdot B = B \cdot A$
2. Associative: $A+(B+C) = (A+B)+C$, $A \cdot (B \cdot C) = (A \cdot B) \cdot C$
3. Distributive: $A \cdot (B+C) = (A \cdot B) + (A \cdot C)$
 $A+(B \cdot C) = (A+B) \cdot (A+C)$
4. Idempotent: $A \cdot A \cdot A \dots A = A$, $X+X+X+\dots+X = X$
5. Identity: $1 \cdot A = A$, $0+A = A$
6. Null: $0 \cdot A = 0$, $1+A = 1$
7. Inverse: $A \cdot \bar{A} = 0$, $A+\bar{A} = 1$
8. Absorption: $A \cdot (A+B) = A$, $A+(A \cdot B) = A$, $A \cdot (\bar{A} \cdot B) = A+B$
9. Double Complement: $\bar{\bar{A}} = A$, $\overline{AB} = \bar{A}\bar{B}$, $\overline{A+B} = \bar{A} \cdot \bar{B}$
10. De Morgan's Theorem: $\overline{A \cdot B} = \bar{A} + \bar{B}$, $\overline{A+B} = \bar{A} \cdot \bar{B}$

Practice:

Q. $A+B+\bar{A}+\bar{B}$

$$\begin{aligned}&\Rightarrow A+B+\bar{A}+\bar{B} \quad \text{Associative law} \\ &\Rightarrow (A+\bar{A})+(B+\bar{B}) \quad \text{Inverse law} \\ &\Rightarrow 1+1 \\ &\Rightarrow 1 \\ &\therefore A+B+\bar{A}+\bar{B} = 1\end{aligned}$$

Q. $A \cdot B \cdot C + \bar{A} \cdot B \cdot C + A \cdot \bar{B} \cdot C + A \cdot B \cdot \bar{C}$ Distributive law

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

$$\begin{aligned}&ABC + \bar{A}BC + A\bar{B}C + AB\bar{C} \quad \text{Associative law} \\ &\Rightarrow ABC + (\bar{A}BC + A\bar{B}C + AB\bar{C}) \quad \text{Distributive law} \\ &\Rightarrow (ABC + \bar{A}BC) + (A\bar{B}C + AB\bar{C}) \quad \text{Distributive law} \\ &\Rightarrow BC(A+\bar{A}) + AC(B+\bar{B}) + AB(C+\bar{C}) \quad \text{Inverse law} \\ &\Rightarrow BC + AC + AB\end{aligned}$$

Q. $\bar{A}A + \bar{A}B + AB + B\bar{B} + AAA + AA\bar{B}$ Inverse law

$$\begin{aligned}&\Rightarrow 0 + \bar{A}B + AB + 0 + AAA + AA\bar{B} \quad \text{Idempotent law/Identity law} \\ &\Rightarrow \bar{A}B + AB + A + A\bar{B} \quad \text{Distributive law} \\ &\Rightarrow B \cdot (\bar{A}+A) + A \cdot (1+\bar{B}) \\ &\quad \text{Inverse} \quad \text{Null} \\ &\Rightarrow B \cdot 1 + A \cdot 1 \quad \text{Identity law} \\ &\Rightarrow B + A \quad \text{Commutative law} \\ &\Rightarrow A+B\end{aligned}$$

Homework:

① O/N 18, P32, Q.3 (9608)

Q. $A\bar{B}\bar{C} + AB\bar{C} + ABC$

② M/J 19, P33, Q.3(c), 9608

Q. $\bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}C\bar{D} + \bar{A}\bar{B}CD + A\bar{B}\bar{C}\bar{D}$

① $A\bar{B}\bar{C} + AB\bar{C} + ABC$ Idempotent law

$$\begin{aligned}&\Rightarrow A\bar{B}\bar{C} + AB\bar{C} + AB\bar{C} + ABC \quad \text{Distributive law} \\ &\Rightarrow A\bar{C}(\bar{B}+B) + AB(\bar{C}+C) \quad \text{Inverse law} \\ &\Rightarrow A\bar{C} \cdot 1 + AB \cdot 1 \quad \text{Identity law} \\ &\Rightarrow A\bar{C} + AB \quad \text{Distributive law} \\ &\Rightarrow A \cdot (\bar{C}+B)\end{aligned}$$

② $\bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}C\bar{D} + \bar{A}\bar{B}CD + A\bar{B}\bar{C}\bar{D} + A\bar{B}\bar{C}D$ Idempotent law

$$\begin{aligned}&\Rightarrow \bar{A}\bar{B}\bar{C}(\bar{D}+D) + \bar{A}\bar{B}C(D+\bar{D}) + A\bar{C}\bar{D}(B+\bar{B}) \quad \text{Distributive law} \\ &\Rightarrow \bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C + A\bar{C}\bar{D} \quad \text{Distributive law} \\ &\Rightarrow \bar{A}\bar{B}(C+\bar{C}) + A\bar{C}\bar{D} \quad \text{Inverse law} \\ &\Rightarrow \bar{A}\bar{B} + A\bar{C}\bar{D} \quad \text{Distributive} \\ &\Rightarrow A(\bar{B} + \bar{C}\bar{D})\end{aligned}$$