Boolean Algebra

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$\bar{A} \Rightarrow$ NOT A
$AB \Rightarrow$ A AND B
$A+B \Rightarrow$ A OR B

Laws:

1. Commutative: $A+B = B+A$, $AB = BA$
2. Associative : $A+(B+C) = (A+B)+C$, $A\cdot(B\cdot C) = (A\cdot B)\cdot C$
3. Distributive : $A\cdot(B+C) = (AB)+(AC)$
   $A+(BC) = (A+B)\cdot(A+C)$
   $A+(B+C) = (A+B)+(A+C)$
   $A\cdot(B\cdot C) = (A\cdot B)\cdot(A\cdot C)$
4. Idempotent: $A\cdot A\cdot A\cdot A \cdots\cdots A = A$
   $A+A+A+\cdots\cdots+A = A$
5. Identity: $1\cdot A = A$, $0+A = A$
6. Null: $0\cdot A = 0$, $1+A = 1$, $1+\bar{A} = 1$, $1+\bar{B} = 1$
7. Inverse: $A\cdot\bar{A} = 0$, $A+\bar{A} = 1$
8. Absorption: $A\cdot(A+B) = A$, $A+(A\cdot B) = A$
   $\left.\begin{array}{l} A+(\bar{A}B) = A+B \\ A\cdot(\bar{A}B) = AB \end{array}\right\}$ Redundancy law
9. Double Complement: $\bar{\bar{A}} = A$, $\overline{\overline{A+B}} = A+B$, $\overline{\overline{AB}} = AB$
10. De-Morgan Theoram: $\overline{AB} = \bar{A}+\bar{B}$, $\overline{A+B} = \bar{A}\cdot\bar{B}$

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

$\equiv$

Absorption law:

$A\cdot(A+B) = A$
$(AA)+(AB)$
$A+AB$
$A\cdot(1+B)$
$A\cdot 1$
A

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

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

$A\cdot(\bar{A}+B) = AB$
$(A\bar{A})+(AB)$
$0 + AB$
AB

Q. $A+B+\bar{A}+\bar{B}$ Associative
$A+\bar{A}+B+\bar{B}$
$(A+\bar{A})+(B+\bar{B})$ Inverse

$1 + 1$
$\therefore 1$

Q. $ABC + \bar{A}BC + A\bar{B}C + AB\bar{C}$ Distributive
$BC(A+\bar{A}) + A(\bar{B}C+B\bar{C})$ Inverse
$BC\cdot 1 + A(\bar{B}C+B\bar{C})$ Identity
$BC + A(\bar{B}C+B\bar{C})$

$ABC + \bar{A}BC + A\bar{B}C + AB\bar{C}$ Associative
$ABC + (\bar{A}BC + A\bar{B}C + AB\bar{C})$ Distributive
$(ABC+\bar{A}BC) + (ABC+A\bar{B}C) + (ABC+AB\bar{C})$ Distributive
$BC\cdot(A+\bar{A}) + AC\cdot(B+\bar{B}) + AB\cdot(C+\bar{C})$ Inverse
$BC\cdot 1 + AC\cdot 1 + AB\cdot 1$ Identity
$BC+AC+AB$

Q. $\bar{A}A + \bar{A}B + AB + B\bar{B} + AAA + AA\bar{B}$ Inverse
$0 + \bar{A}B + AB + 0 + AAA + AA\bar{B}$ Idempotent
$\bar{A}B + AB + A + A\bar{B}$ Distributive
$B\cdot(\bar{A}+A) + A\cdot(1+\bar{B})$ Inverse
$B\cdot 1 + A\cdot 1$ Identity
$B+A$

Homework:

Q. O/N 18, P32, Q3 (9608)

Q. M/J 19, P33, Q3c (9608)