Logic Algebra Rules

literals $a, b, c, \ldots \in \{T, F\}$
$\in \{1, 0\}$

negation distributes over "and":

$$\neg(\underbrace{a \wedge b}_{\text{and}}) = \neg a \underbrace{\vee}_{\text{OR}} \neg b$$

$\neg(a \wedge b)$	$\neg a \vee \neg b$	$\neg b$	$\neg a$	$a \wedge b$ = and	a	b	$a \vee b$
1	1	1	1	0	0	0	0
1	1	0	1	0	0	1	1
1	1	1	0	0	1	0	1
0	0	0	0	1	1	1	1

negate $\neg$

$\neg T = F$
$\neg F = T$

check in english / common sense.

a = I am rich, b = win NOBEL prize

$\neg(a \wedge b)$ = Its not true that both I'm rich and I'm winning NOBEL

$(\neg a) \vee (\neg b)$ = I'm not rich either OR I did not win NOBEL

did not do Both

$$\neg(\underbrace{a \vee b}_{\text{OR}}) = \neg a \underbrace{\wedge}_{\text{and}} \neg b$$

not true that either $\underline{\text{rich}}^{a}$ or $\underline{\text{win NOBEL}}^{b}$

I am $\underbrace{\boxed{\text{not rich}}}_{\neg a}$ and $\underbrace{\text{not winning NOBEL}}_{\neg b}$

$$a \wedge (b \vee c) = (a \wedge b) \vee (a \wedge c)$$

$F \Rightarrow$ anything

$\boxed{\text{careful: implication}}$

a	b	$a \Rightarrow b$	$\neg(a \Rightarrow b)$	$a \wedge \neg b$
0	0	1	0	0
0	1	1	0	0
1	0	0	1	1
1	1	1	0	0

$$\neg(a \Rightarrow b) \xLeftrightarrow[\text{same}]{} a \wedge \neg b$$

$\equiv$

implication $a \Rightarrow b$ fails iff
a = true = premise $\wedge$
b = false conclusion