Logical Equivalences

Given any statement variables p, q, and r, a tautology $\mathbf{t}$, and a contradiction $\mathbf{c}$, the following logical equivalences hold:

1.	Commutative laws:	$p \wedge q \equiv q \wedge p$	$p \vee q \equiv q \vee p$
2.	Associative laws:	$(p \wedge q) \wedge r \equiv p \wedge (q \wedge r)$	$(p \vee q) \vee r \equiv p \vee (q \vee r)$
3.	Distributive laws:	$p \wedge (q \vee r) \equiv (p \wedge q) \vee (p \wedge r)$	$p \vee (q \wedge r) \equiv (p \vee q) \wedge (p \vee r)$
4.	Identity laws:	$p \wedge \mathbf{t} \equiv p$	$p \vee \mathbf{c} \equiv p$
5.	Negation laws:	$p \vee \neg\, p \equiv \mathbf{t}$	$p \wedge \neg\, p \equiv \mathbf{c}$
6.	Double negative law:	$\neg(\neg p) \equiv p$	
7.	Idempotent laws:	$p \wedge p \equiv p$	$p \vee p \equiv p$
8.	Universal bound law:	$p \vee \mathbf{t} \equiv \mathbf{t}$	$p \wedge \mathbf{c} \equiv \mathbf{c}$
9.	De Morgan's laws:	$\neg(p \wedge q) \equiv \neg\, p \vee \neg\, q$	$\neg(p \vee q) \equiv \neg\, p \wedge \neg\, q$
10.	Absorption law:	$p \vee (p \wedge q) \equiv p$	$p \wedge (p \vee q) \equiv p$
11.	Negations of $\mathbf{t}$ and $\mathbf{c}$:	$\neg\mathbf{t} \equiv \mathbf{c}$	$\neg\mathbf{c} \equiv \mathbf{t}$
12.	Division into cases:	$p \vee q \to r \equiv (p \to r) \wedge (q \to r)$	
13.	Implication as or:	$p \to q \equiv \neg p \vee q$	
14.	Negating a conditional:	$\neg(p \to q) \equiv p \wedge \neg q$	
15.	Contrapositive:	$p \to q \equiv \neg q \to \neg p$	
16.	iff as implications:	$p \leftrightarrow q \equiv (p \to q) \wedge (q \to p)$	