Cheat Sheet

Logical Equivalences

Identity: $p \wedge \boldsymbol{T} \equiv p$
$p \vee \boldsymbol{F} \equiv p$
Domination: $p \vee \boldsymbol{T} \equiv \boldsymbol{T}$
$p \wedge \boldsymbol{F} \equiv \boldsymbol{F}$
Idempotent: $p \vee p \equiv p$
$p \wedge p \equiv p$
Double negation: $\neg(\neg p) \equiv p$
Commutative: $p \vee q \equiv q \vee p$
$p \wedge q \equiv q \wedge p$
Associative: $(p \vee q) \vee r \equiv p \vee (q \vee r)$
$(p \wedge q) \wedge r \equiv p \wedge (q \wedge r)$
Distributive: $p \vee (q \wedge r) \equiv (p \vee q) \wedge (p \vee r)$
$p \wedge (q \vee r) \equiv (p \wedge q) \vee (p \wedge r)$
De Morgan's: $\neg(p \wedge q) \equiv \neg p \vee \neg q$
$\neg(p \vee q) \equiv \neg p \wedge \neg q$
Absorption: $p \vee (p \wedge q) \equiv p$
$p \wedge (p \vee q) \equiv p$
Negation: $p \vee \neg p \equiv \boldsymbol{T}$
$p \wedge \neg p \equiv \boldsymbol{F}$

Conditional Statements

$p \to q \equiv \neg p \vee q$
$p \to q \equiv \neg q \to \neg p$
$p \vee q \equiv \neg p \to q$
$p \wedge q \equiv \neg(p \to \neg q)$
$(p \to q) \wedge (p \to r) \equiv p \to (q \wedge r)$
$(p \to r) \wedge (q \to r) \equiv (p \vee q) \to r$
$(p \to q) \vee (p \to r) \equiv p \to (q \vee r)$
$(p \to r) \vee (q \to r) \equiv (p \wedge q) \to r$

Biconditional Statements

$p \iff q \equiv (p \to q) \wedge (q \to p)$
$p \iff q \equiv \neg p \iff \neg q$
$p \iff q \equiv (p \wedge q) \vee (\neg p \wedge \neg q)$
$\neg(p \iff q) \equiv p \iff \neg q$

Rules of Inference

p $p \to q$ $\therefore q$	Modus ponens
$\neg q$ $p \to q$ $\therefore \neg p$	Modus tollens
$p \to q$ $q \to r$ $\therefore p \to r$	Hypothetical syllogism
$p \vee q$ $\neg p$ $\therefore q$	Disjunctive syllogism
p $\therefore p \vee q$	Addition
$p \wedge q$ $\therefore p$	Simplification
p q $\therefore p \wedge q$	Conjunction
$p \vee q$ $\neg p \vee r$ $\therefore q \vee r$	Resolution

Logic Gates