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5) $\sim(P \lor Q) \leftrightarrow (P \land Q) = $ DNF

$\sim(P \lor Q) \leftrightarrow (P \land Q) \leftrightarrow (\sim(P \lor Q) \land (P \land Q))) \lor ((P \lor Q) \land \sim(P \land Q))$

$\sim(P \lor Q) \leftrightarrow (P \land Q) \leftrightarrow (\sim P \land \sim Q \land P \land Q) \lor ((P \lor Q) \land (\sim P \lor \sim Q))$

$\Rightarrow (\sim P \land \sim Q \land P \land Q) \lor ((P \lor Q \land (\sim P \lor \sim Q))$

$\leftrightarrow (\sim P \land \sim Q \land P \land Q) \lor ((P \lor Q) \land \sim P) \lor ((P \lor Q) \land \sim Q)$

$\leftrightarrow (\sim P \land \sim Q \land P \land Q) \lor (P \land \sim P) \lor (Q \land \sim P) \lor (P \land \sim Q) \lor (Q \land \sim Q)$

6) $P \lor \{ \sim P \longrightarrow (q \lor (q \rightarrow \sim r))\}$

$P \lor \{\sim P \rightarrow (q \lor (\sim q \lor \sim r))\}$

$P \lor \{\sim \sim P \lor (q \lor (\sim q \lor \sim r)\}$

$P \lor \{ P \lor (q \lor (\sim q \lor \sim r)\}$

$P \lor \{ P \lor (q \lor \sim q) \lor (q \lor \sim r)\}$

$P \lor P \lor (q \lor \sim q) \lor (q \lor \sim r) = $ DNF

7) CNF $\Rightarrow \sim(P \lor Q) \longrightarrow (P \land Q)$

$\sim(P \lor Q) \leftrightarrow (P \land Q)$

$\leftrightarrow (\sim(P \lor Q) \longrightarrow (P \land Q)) \land ((P \land Q) \rightarrow \sim(P \lor Q))$

$\leftrightarrow \sim(P \lor Q) \leftrightarrow (P \land Q) \Leftrightarrow ((P \lor Q) \lor (P \land Q)) \land (\sim(P \land Q) \lor (\sim P \land \sim Q))$

$\Rightarrow ((P \lor Q \lor P) \land (P \lor Q \lor Q)) \land ((\sim P \lor \sim Q) \lor (\sim P \land \sim Q))$

$\Leftrightarrow (P \lor Q \lor P) \land (P \lor Q \lor Q) \land (\sim P \lor \sim Q \lor \sim P) \land (\sim P \lor \sim Q \lor \sim Q)$

$=$

(8) DNF of $(p \to q) \land (\sim p \land q)$ and $(p \land (p \to q)) \to q$

$(p \to q) \land (\sim p \land q)$

$\Rightarrow (\sim p \lor q) \land (\sim p \land q)$

$\Rightarrow (\sim p \land q) \land (\sim p \lor q)$

$\Rightarrow (\sim p \land q \land \sim p) \lor (\sim p \land q \land q) \quad \longrightarrow$ DNF

$p \land (p \to q) \longrightarrow q$

$(p \land (\sim p \lor q)) \longrightarrow q$

$\sim (p \land (\sim p \lor q) \lor q$

$\sim p \lor \sim (\sim p \lor q) \lor q$

$\sim p \lor (p \land \sim q) \lor q$

$\sim p \lor (p \land \sim q) \lor q$

$\sim (p \land p) \lor (p \land \sim q) \lor (q \land q) \longrightarrow$ DNF

9) $(p \land q) \land (q \to p)$

$(p \land q) \land (\sim q \lor p)$

$(p \land \sim q) \times (p \land p) \lor (q \land \sim q) \land (q \land p)$

$= (p \land \sim q) \land p \lor \phi \land (q \land p)$

$= (p \land \sim q \land p) \land (q \land p \lor q) \longrightarrow$ DNF

$(p \land q) \land (q \to p)$

$(p \land q) \land (\sim q \lor p)$

$(\sim q \lor p) \land (p \land q)$

$(\sim q \lor p) \land ((p \land q)')$

$(\sim q \land p) \land \sim (\sim p \lor \sim q) \longrightarrow$ CNF