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HOMEWORK-2

DMS

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CSE-4
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1. Idempotent law.

P	P	P∨P	P∧P
T	T	T	T
F	F	F	F

Since their truth values are identical, they are equivalent.

∴ $(P \vee P) \Longleftrightarrow P$, $(P \wedge P) \Longleftrightarrow P$

2. Commutative law.

P	Q	P∨Q	Q∨P	P∧Q	Q∧P
T	T	T	T	T	T
T	F	T	T	F	F
F	T	T	T	F	F
F	F	F	F	F	F

∴ $(P \vee Q) \Longleftrightarrow Q \vee P$, $(P \wedge Q) \Longleftrightarrow (Q \wedge P)$

3. Associative law.

P	Q	R	P∨Q	Q∨R	(P∨Q)∨R	P∨(Q∨R)	P∧Q	Q∧R	(P∧Q)∧R	P∧(Q∧R)
T	T	T	T	T	T	T	T	T	T	T
T	T	F	T	T	T	T	T	F	F	F
T	F	T	T	T	T	T	F	F	F	F
T	F	F	T	F	T	T	F	F	F	F
F	T	T	T	T	T	T	F	T	F	F
F	T	F	T	T	T	T	F	F	F	F
F	F	T	F	T	T	T	F	F	F	F
F	F	F	F	F	F	F	F	F	F	F

∴ $(P \vee Q) \vee R \Longleftrightarrow P \vee (Q \vee R)$, $(P \wedge Q) \wedge R \Longleftrightarrow P \wedge (Q \wedge R)$

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4. Distributive law.

P	Q	R	Q∧R	Pv(Q∧R)	PvQ	PvR	(PvQ)∧(PvR)
T	T	T	T	T	T	T	T
T	T	F	F	T	T	T	T
T	F	T	F	T	T	T	T
T	F	F	F	T	T	T	T
F	T	T	T	T	T	T	T
F	T	F	F	F	T	F	F
F	F	T	F	F	F	T	F
F	F	F	F	F	F	F	F

QvR	P∧(QvR)	P∧Q	P∧R	(P∧Q)v(P∧R)
T	T	T	T	T
T	T	T	F	T
T	T	F	T	T
F	F	F	F	F
T	T	F	F	F
T	F	F	F	F
T	F	F	F	F
F	F	F	F	F

∴ $P \vee (Q \wedge R) \iff (P \vee Q) \wedge (P \vee R)$

$P \wedge (Q \vee R) \iff (P \wedge Q) \vee (P \wedge R)$

5.

P	T	F	PvF	P∧T
T	T	F	T	T
F	T	F	F	F

∴ $P \vee F \iff P$, $P \wedge T \iff P$

6.

P	T	F	PvT	P∧F
T	T	F	T	F
F	T	F	T	F

∴ $P \vee T \iff T$, $P \wedge F \iff F$

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7.

P	¬P	T	F	P∨¬P	P∧¬P
T	F	T	F	T	F
F	T	T	F	T	F

$\therefore$ $P \vee \neg P \Leftrightarrow T$, $P \wedge \neg P \Leftrightarrow F$

8. Absorption law.

P	Q	P∧Q	P∨(P∧Q)	P∨Q	P∧(P∨Q)
T	T	T	T	T	T
T	F	F	T	T	T
F	T	F	F	T	F
F	F	F	F	F	F

$\therefore$

$P \vee (P \wedge Q) \Leftrightarrow P$

$P \wedge (P \vee Q) \Leftrightarrow P$

9. De Morgan's Law.

P	Q	¬P	¬Q	P∨Q	¬(P∨Q)	¬P∧¬Q
T	T	F	F	T	F	F
T	F	F	T	T	F	F
F	T	T	F	T	F	F
F	F	T	T	F	T	T

P∧Q	¬(P∧Q)	¬P∨¬Q
T	F	F
F	T	T
F	T	T
F	T	T

$\therefore$ $\neg(P \vee Q) \Leftrightarrow \neg P \wedge \neg Q$, $\neg(P \wedge Q) \Leftrightarrow \neg P \vee \neg Q$

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