

1. • $(P \vee Q) \rightarrow (\neg P \wedge Q)$

P	Q	$P \vee Q$	$\neg P$	$\neg P \wedge Q$	$(P \vee Q) \rightarrow (\neg P \wedge Q)$
T	T	T	F	F	F
T	F	T	F	F	F
F	T	T	T	T	T
F	F	F	T	F	T

• $(P \vee Q) \rightarrow (\neg P \wedge Q)$

• $\neg((P \wedge Q) \rightarrow (P \vee Q))$

P	Q	$P \wedge Q$	$P \vee Q$	$(P \wedge Q) \rightarrow (P \vee Q)$	$\neg((P \wedge Q) \rightarrow (P \vee Q))$
T	T	T	T	T	F
T	F	F	T	T	F
F	T	F	T	T	F
F	F	F	F	T	F

• $(P \wedge Q) \rightarrow (P \vee Q)$

2. $(q \vee r \rightarrow p) \wedge (q \rightarrow r) \wedge \neg r$

p	q	r	$q \vee r$	$q \vee r \rightarrow p$	$q \rightarrow r$	$\neg r$	$(q \vee r \rightarrow p) \wedge (q \rightarrow r) \wedge \neg r$
T	T	T	T	T	T	F	F
T	T	F	T	T	F	T	F
T	F	T	T	T	T	F	F
T	F	F	F	T	T	T	T
F	T	T	T	F	T	F	F
F	T	F	T	F	F	T	F
F	F	T	T	F	T	F	F
F	F	F	F	T	T	T	T

not valid there are some F for this formula

3. $(q \vee r \rightarrow p) \vee (q \rightarrow r) \vee \neg r$

P	q	r	$q \vee r \rightarrow p$	$q \rightarrow r$	$\neg r$	$(q \vee r \rightarrow p) \vee (q \rightarrow r) \vee \neg r$
T	T	T	T	T	F	T
T	T	F	T	F	T	T
T	F	T	T	T	F	T
T	F	F	T	T	T	T
F	T	T	F	T	F	T
F	T	F	F	F	T	T
F	F	T	F	T	F	T
F	F	F	T	T	T	T

it is valid there are all T for this formula

4. $\phi(P_0 \vee P_1) = T$ because $P_0 = \neg P_1$, $P_1 = \neg P_0$

as same as above

$$\phi(Q_0 \vee Q_1) = T, \phi(R_0 \vee R_1) = T, \phi(S_0 \vee S_1) = T$$

$$\phi(\neg P_0 \vee \neg P_1) = T \text{ because } P_0 = \neg P_1, P_1 = \neg P_0$$

as same as above

$$\phi(\neg Q_0 \vee \neg Q_1) = T, \phi(\neg R_0 \vee \neg R_1) = T, \phi(\neg S_0 \vee \neg S_1) = T$$

$$\phi(P_0 \vee Q_0) = T \text{ because each row has exactly one 0 and one 1}$$

$$\phi(P_1 \vee Q_1) = T$$

as same as above

$$\phi(R_0 \vee S_0) = T, \phi(R_1 \vee S_1) = T$$

$$\phi(P_0 \vee R_0) = T \text{ because each column has exactly one 0 and one 1}$$

$$\phi(P_1 \vee R_1) = T$$

as same as above

$$\phi(Q_1 \vee S_1) = T, \phi(Q_0 \vee S_0) = T$$

\therefore it is T