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CSE150
HW01a

Problem 1:

Write $P \Rightarrow Q$ using $\vee$ and $\sim$. Show that your two representations are equivalent.

P	Q	$\sim$P	P$\Rightarrow$Q	$\sim$P $\vee$ Q
T	T	F	T	T
T	F	F	F	F
F	T	T	T	T
F	F	T	T	T

$\sim P \vee Q$

Problem 2:

Prove that the propositional formulas

$$P \vee Q \vee R$$

and

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

are equivalent.

P	Q	R	$\sim$P	$\sim$Q	$\sim$R	P $\vee$ Q $\vee$ R	P $\wedge \sim$Q	Q $\wedge \sim$R	R $\wedge \sim$P	P $\wedge$ Q $\wedge$ R
T	T	T	F	F	F	T	F	F	F	T
T	T	F	F	F	T	T	F	T	F	F
T	F	T	F	T	F	T	T	F	F	F
T	F	F	F	T	T	T	T	F	F	F
F	T	T	T	F	F	T	F	F	T	F
F	T	F	T	F	T	T	F	T	F	F
F	F	T	T	T	F	T	F	F	T	F
F	F	F	T	T	T	F	F	F	F	F

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

T
T
T
T
T
T
T
F

Problem 3:

(a) Write the biconditional ($\Leftrightarrow$) using only implies ($\Rightarrow$) and ($\wedge$). Prove that the new version is equivalent.

P	Q	$P \Rightarrow Q$	$Q \Rightarrow P$	$(P \Rightarrow Q) \wedge (Q \Rightarrow P)$
T	T	T	T	T
T	F	F	T	F
F	T	T	F	F
F	F	T	T	T

$(P \Rightarrow Q) \wedge (Q \Rightarrow P)$

(b) Write it using only $\vee$ and $\sim$. Show your derivation.

1. $P \Leftrightarrow Q$
2. $(P \Rightarrow Q) \wedge (Q \Rightarrow P)$ *[by Problem 3a]*
3. $(\sim P \vee Q) \wedge (\sim Q \vee P)$ *[by Problem 1]*
4. $\sim(\sim(\sim P \vee Q)) \vee \sim(\sim Q \vee P))$ *[by De Morgan's Laws]*

$\sim(\sim(\sim P \vee Q)) \vee \sim(\sim Q \vee P))$