1. Construct truth tables for the following propositional forms.

(i) $P \wedge (Q \vee R)$ (iii) $\neg(P \wedge Q)$ (v) $\neg P \vee Q$

(ii) $(P \wedge Q) \vee (P \wedge R)$ (iv) $(\neg P) \vee (\neg Q)$ (vi) $P \Rightarrow Q$

2. Use the first problem to deduce that for any propositional forms P, Q and R,

(i) $P \wedge (Q \vee R)$ and $(P \wedge Q) \vee (P \wedge R)$ are equivalent.

(Distributive laws.)

(ii) $\neg(P \wedge Q)$ and $(\neg P) \vee (\neg Q)$ are equivalent.

(DeMorgan's law)

(iii) $P \Rightarrow Q$ and $\neg Q \Rightarrow \neg P$ are equivalent.

($\neg Q \Rightarrow \neg P$ is called the contrapositive of $P \Rightarrow Q$.)

3. Explain why "This sentence is false" is NOT a proposition.

4. Complete the following truth table.

x	y	$x<y$	$x=y$	$x\leq y$
1	1			
1	0			
0	1			

5. Prove that $|x+y| \leq |x|+|y|$ for every real numbers x and y.

6. Find a propositional form expressed only in terms of $P, Q, R, \wedge, \vee, \neg, (,)$ whose truth table is the following:

P	Q	R	$*$	
T	T	T	F	
T	T	F	T	→ ①
T	F	T	F	
T	F	F	T	→ ②
F	T	T	F	
F	T	F	T	→ ③
F	F	T	F	
F	F	F	F	

(Hint: $*$ is true if and only if ① holds or ② holds or ③ holds

① holds if and only if $P \wedge Q \wedge \neg R$ is true.

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