HW 01: Propositional Logic (v1.1)

This is an ungraded homework. Solve the following problems; we'll discuss answers early in class on August 31. **[*v*1.1: Typo fixes in bold red]**

1. Throw away as many parentheses from the following proposition as possible:
   $\neg(p \wedge ((\neg q) \rightarrow r)$ **)** $\vee (s \wedge t \wedge v)$ **[Right paren added before $\vee$]**

2. Fill in the missing rule names in the proof below. Use the rules that we used in Class 01 (Mon, Aug 24).

   $\neg(p \rightarrow q)$
   iff $\neg(\neg p \vee q)$ Defn $\rightarrow$
   iff $\neg\neg p \wedge \neg q$ _____
   iff $p \wedge \neg q$ _____

3. Repeat Problem 2 on the following proof. (Some of the lines might need two rules.) Note that the proof shows that the first line is a tautology.

   $\neg(p \wedge q) \rightarrow \neg p \vee \neg q$
   iff $\neg\neg(p \wedge q) \vee (\neg p \vee \neg q)$ Defn $\rightarrow$
   iff $p \wedge q \vee \neg p \vee \neg q$ _____
   iff $(p \vee \neg p) \wedge (q \vee \neg p) \vee \neg q$ _____ **[$\neg$ added before last q]**
   $q \vee \neg p \vee \neg q$ _____
   $T \vee \neg p$ _____
   T _____

4. Write a formal proof that shows that $p \rightarrow p \vee q$ (sometimes called the "$\vee$ introduction" rule) is a tautology..

5. Write a formal proof that $\neg(p \leftrightarrow q)$ iff $(p \wedge \neg q) \vee (q \wedge \neg p)$. [Hint: Use Problem 2.]

6. Write a formal proof that shows that $p \rightarrow q \rightarrow p \wedge q$ (the "$\wedge$ **introduction**" rule) is a tautology. **[The $\wedge$ elimination rules are $p \wedge q \rightarrow p$ and $p \wedge q \rightarrow q$.]**