1, Prove that

$(p \rightarrow r) \vee (q \rightarrow r) \leftrightarrow (p \wedge q) \rightarrow r$

2. Prove that

$\neg(p \leftrightarrow q) \leftrightarrow (p \leftrightarrow \neg q)$

3. Show that there are 16 different propositional formulas in p and q. But $\neg, \wedge, \vee$ are the only ones one needs to express all others. For example $p \rightarrow q \leftrightarrow \neg p \vee q$

In general any propositional formula $P(p_1, \ldots, p_n)$ is equivalent to a disjunction of conjunctions in p_i and $\neg p_j$. Similarly, any $P(p_1, \ldots, p_n)$ is equialent to a conjunction of disjunctions in p_i and $\neg p_j$.