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Exercises of Logic Proof

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1. Prove using a resolution that $p \to (q \wedge r) = (\neg q \wedge \neg r) \to \neg p$.
2. Use resolution to prove that $p \to q$ is a logical consequence of

   $((t \to q) \wedge (\neg r \to \neg s) \wedge (p \to u) \wedge (\neg t \to \neg r) \wedge (u \to s)$
3. Prove with a resolution that the following are tautologies.

   a. $p \to (q \to p)$

   b. $(p \wedge (p \to q)) \to q$

   c. $(p \to q) \wedge \neg q) \to \neg p$

   d. $(p \to q) \wedge \neg q) \to \neg q$
4. Give the structure proof of.

   a. $(p \to q) \to ((q \to r) \to (p \to r))$

   b. $(p \to q) \to ((r \to \neg q) \to (p \to \neg r))$

   c. $(p \to (q \to r)) \to (\neg r \to (p \to \neg q$
5. Proof that $\sqrt{2} + \sqrt{3} + \sqrt{5}$ is irrational.
6. Proof by contradiction the following statement

   if a , b are positive real number then $a + b \geq 2\sqrt{ab}$.
7. Proof by contradiction the following statement

   when x real number then $(5x + 3)^2 + 1 \geq (3x - 1)^2$.
8. Proof by contradiction the following statement

   for all value of θ Show that $Sin\theta + Cos\theta \leq \sqrt{2}$.
9. Prove the statements below

   a. $For\ all\ k \in \mathbb{N}, k^3 + 2k\ is\ divisible\ by\ 3.$

   b. $For\ all\ k \in \mathbb{N}, k^4 - 6k^3 + 11k^3 - 6k\ is\ divisible\ by\ 4.$

   c. $For\ all\ k \in \mathbb{N}, k^3 + 5k\ is\ divisible\ by\ 6.$