1. **(7 points)** Consider the true statement "For every real number x, if $x > 2$, then $x^2 > 4$." Write its negation as a quantified statement in words or symbols and briefly explain why this new statement must be false.

2. **(18 points)** Find sets satisfying the conditions below, or briefly explain why it is impossible to find such sets:

   (a) Sets R, S, and T such that $R \in S$, $S \in T$, and $S \subsetneq T$.

   (b) Sets A and B such that $A \subseteq \mathbb{N}$, $B \subseteq \mathbb{N}$, and $A \in B$.

   (c) Finite sets X, Y, and Z such that $X \subseteq Z$, $Y \subseteq Z$, $|X| = |Y|$, and $|X \cap Y| = 2$.

3. **(19 points)** Prove that for any integer n, if $n^2 + 4n + 1$ is even, then n is odd.

4. **(8 points)** The statement "for any natural number n, if n has an odd number of factors, then it is a perfect square" is true. State its converse. Is the converse true or not? Briefly explain your reasoning.

5. **(15 points)** Prove that for integers a, b, and c, if a and c are both odd, then $ab + bc$ is even.

6. **(15 points)** Fill in the truth table for each of the following statements, and identify the statement as a tautology, a contradiction, or neither.

   (a) $P \wedge (Q \to \sim P)$.

P	Q	

   (b) $(P \wedge Q) \leftrightarrow (P \to \sim Q)$.

P	Q	

   (c) $(P \to Q) \to (Q \to P)$.

P	Q	

7. **(18 points)** Prove that for any integer n, $3n^2 - 5n$ is even.