1. [10 pts] Are the two statements \((p \land q) \lor \neg q\) and \(p \rightarrow q\) logically equivalent? Justify your answer with a truth table and a short sentence of explanation.

2. (a) [4 pts] Let \(p = \) my dog is brown, \(q = \) my cat is big, and \(r = \) I like pizza. Convert \(\neg(p \lor q) \iff r\) to a verbal statement.
   (b) [6 pts] Convert to completely symbolic form: “For every positive number \(x\), if \(y\) is positive, then there is a natural number \(z\) for which \(xz > y\).”

3. [9 pts - 3 each] Rewrite the following statements in the form “If ..., then ....”
   (a) You’ll only get a cookie if you clean your plate first.
   (b) To get a driver’s license, it’s necessary to pass the written test.
   (c) \(\sqrt{2}\) is an irrational number.

4. Symbolically negate the following, simplifying as much as possible:
   (a) [4 pts] \((A > B) \rightarrow (A^2 > 3B)\)
   (b) [6 pts] \(\exists x, (\forall y, xy > 1) \land x\) is even.

5. [5 pts] Give a complete, correctly phrased counterexample to the claim: “If \(a\) and \(b\) are real numbers satisfying \(a^2 > b^2\), then \(a > b\).”

6. Consider: “If \(x\) and \(y\) are consecutive odd integers, then \(xy + 1\) is a perfect square.”
   (a) [5 pts] If you were going to write a direct proof of this result, what would you assume (be explicit), and what would you try to show?
   (b) [5 pts] If you were going to write a proof by contradiction of this result, what would you assume (be explicit), and what would you try to show?
   (c) [5 pts] If you were going to write a proof by contrapositive of this result, what would you assume (be explicit), and what would you try to show?

7. [12 pts] Prove by using mathematical induction: \(3 + 3^2 + 3^3 + \cdots + 3^n = \frac{3^{n+1}-1}{2}\).

8. Let the universal set be \(U = \{1, 2, 3, 4, 5, 6\}\), and let \(A = \{2, 4, 6\}\), \(B = \{1, 2, 3\}\), and \(C = \{4, 5\}\).
   (a) [3 pts] Use the symbol \(\subseteq\) correctly in a statement about \(A\).
   (b) [4 pts] List the elements of \(B \cup (A \cap C)\).
   (c) [4 pts] List the elements of \(\overline{A}\) \(\setminus C\).
   (d) [3 pts] List the elements of \(\mathcal{P}(C)\), the power set of \(C\).

9. [8 pts] Use a Venn diagram with sets \(P\) and \(Q\) to determine whether \((P \cap Q) \cup \overline{Q} = \overline{P}\).

10. Take-Home Question [7 pts]: (Due Wednesday) Prove the statement from Question #6 directly. You may refer to your notes and text, but do not seek help from any other source, especially human. I will severely penalize cheating.