50. It is enough to find a counterexample. It is intuitively clear that the first proposition is asserting much more than the second. It is saying that one of the two predicates, \( P \) or \( Q \), is universally true; whereas the second proposition is simply saying that for every \( x \) either \( P(x) \) or \( Q(x) \) holds, but which it may well depend on \( x \). As a simple counterexample, let \( P(x) \) be the statement that \( x \) is odd, and let \( Q(x) \) be the statement that \( x \) is even. Let the domain of discourse be the positive integers. The second proposition is true, since every positive integer is either odd or even. But the first proposition is false, since it is neither the case that all positive integers are odd nor the case that all of them are even.

52. a) This is false, since there are many values of \( x \) that make \( x > 1 \) true.
   b) This is false, since there are two values of \( x \) that make \( x^2 = 1 \) true.
   c) This is true, since by algebra we see that the unique solution to the equation is \( x = 3 \).
   d) This is false, since there are no values of \( x \) that make \( x = x + 1 \) true.

54. There are only three cases in which \( \exists x!P(x) \) is true, so we form the disjunction of these three cases. The answer is thus \( (P(1) \land \neg P(2) \land \neg P(3)) \lor (\neg P(1) \land P(2) \land \neg P(3)) \lor (\neg P(1) \land \neg P(2) \land P(3)) \).

56. A Prolog query returns a yes/no answer if there are no variables in the query, and it returns the values that make the query true if there are.
   a) None of the facts was that Kevin was enrolled in EE 222. So the response is no.
   b) One of the facts was that Kiko was enrolled in Math 273. So the response is yes.
   c) Prolog returns the names of the courses for which Grossman is the instructor, namely just cs301.
   d) Prolog returns the names of the instructor for CS 301, namely grossman.
   e) Prolog returns the names of the instructors teaching any course that Kevin is enrolled in, namely chan, since Chan is the instructor in Math 273, the only course Kevin is enrolled in.

58. Following the idea and syntax of Example 28, we have the following rule:
   \[
   \text{grandfather}(X,Y) :- \text{father}(X,Z), \text{father}(Z,Y); \text{father}(X,Z), \text{mother}(Z,Y).
   \]
   Note that we used the comma to mean “and” and the semicolon to mean “or.” For \( X \) to be the grandfather of \( Y \), \( X \) must be either \( Y \)’s father’s father or \( Y \)’s mother’s father.

60. a) \( \forall x (P(x) \rightarrow Q(x)) \)
   b) \( \exists x (R(x) \land \neg Q(x)) \)
   c) \( \exists x (R(x) \land \neg P(x)) \)
   d) Yes. The unsatisfactory excuse guaranteed by part (b) cannot be a clear explanation by part (a).

62. a) \( \forall x (P(x) \rightarrow \neg S(x)) \)
   b) \( \forall x (R(x) \rightarrow S(x)) \)
   c) \( \forall x (Q(x) \rightarrow P(x)) \)
   d) \( \forall x (Q(x) \rightarrow \neg R(x)) \)
   e) Yes. If \( x \) is one of my poultry, then he is a duck (by part (c)), hence not willing to waltz (part (a)). Since officers are always willing to waltz (part (b)), \( x \) is not an officer.