Homework #9

Name _____ Sec ____

Questions:	Answers:
1. Translate the following into predicate calculus. For each answer, also state your assumed universe of discourse. a) “Anyone who was an ancient Roman and tried to kill Caesar was not loyal to Caesar.” b) “All cats which are calico, are female.” c) “Some Texans have never left the state of Texas.”	
2. A universe contains the three individuals a, b, and c. For these individuals, a predicate Q(x, y) is defined, and its truth values are given by the following table: x\y | a b c a | T F T b | F T F c | F T T Write each of the following expressions without quantifiers (i.e. convert them to expressions with ANDs and ORs or both) and then evaluate the expression. a) $\forall x \exists y Q(x, y)$ b) $\forall y Q(y, b)$ c) $\forall y Q(y,y)$	

3. Let D = {1, 2} be the universe of discourse. Give an interpretation that makes the expression: $\forall xP(x, y) \vee \neg \forall zQ(z)$ a) false b) true. You should know formally what an interpretation is. Be sure to make your answer conform to the definition for an interpretation. c) Why does answering this question show that the expression is neither valid nor contradictory?	
4. Consider the expression: $\forall x \exists y(\text{thirsty}(x) \wedge \text{juice}(y) \Rightarrow \text{drinks}(x, y))$ a) Give an interpretation with at least two thirsty objects that makes the expression true. b) Give an interpretation such that drinks(john, mango) holds but the expression is false. You should know formally what an interpretation is. Be sure to make your answer conform to the definition of an interpretation.	

5. Using the facts in the class university database in Discussion #15, write predicate logic statements to answer the following questions. a) What are the names of students who live at 12 Apple St.? b) What are the names of students who are getting an A in CS101? Your predicate logic statements must answer these questions for any state of the database, not just the one in the discussion slides.	
6. Algebraically transform: $\neg\forall x(P(x) \wedge Q(y) \Rightarrow \exists z R(z))$ to $\exists x \forall z(P(x) \wedge Q(y) \wedge \neg R(z))$ Justify each step with one or more laws.	
7. Consider the following expression: $\forall x \exists y(P(y, x) \wedge \exists x Q(y, x)) \vee R(x) \wedge \exists y R(y)$. a) Identify the subexpression in the scope of $\forall x$. b) Identify the free variables. c) Identify each bound variable and the quantifier to which it is bound. d) Rectify the expression. (“Rectification is also called “standardizing variables apart.”)	