Attendance Problems 2: Due October 8

Answer these questions throughout the upcoming week and bring this completed sheet to CS103A next week. This will count as your attendance for Week 3. Circle the correct choice for each question, briefly justifying your answer.

Lecture 04: First-Order Logic, Part I

1) Suppose that "You" and "Him" are constant symbols. Consider the following first-order logic statement:

\[ A(\text{You}, \text{Him}) \leftrightarrow ((B(\text{You}) = B(\text{Him})) \land C(\text{You}, \text{Him})) \]

Based on the context in which each of the terms above is used, which of the following must be true?

(Hint: You may find it helpful to do the questions in Homework Problems 2 about Lecture 04 before doing this problem.)

A) \( A \) is a predicate, \( B \) is a predicate, and \( C \) is a predicate.
B) \( A \) is a predicate, \( B \) is a predicate, and \( C \) is a function.
C) \( A \) is a predicate, \( B \) is a function, and \( C \) is a predicate.
D) \( A \) is a predicate, \( B \) is a function, and \( C \) is a function.
E) \( A \) is a function, \( B \) is a predicate, and \( C \) is a predicate.
F) \( A \) is a function, \( B \) is a predicate, and \( C \) is a function.
G) \( A \) is a function, \( B \) is a function, and \( C \) is a predicate.
H) \( A \) is a function, \( B \) is a function, and \( C \) is a function.

Explanation:

2) Which of the following is the proper way of expressing the statement "everything that has a beginning has an end" in first-order logic?

A) \( \forall x. (\text{HasBeginning}(x) \rightarrow \text{HasEnd}(x)) \)
B) \( \exists x. (\text{HasBeginning}(x) \rightarrow \text{HasEnd}(x)) \)
C) \( \forall x. (\text{HasBeginning}(x) \land \text{HasEnd}(x)) \)
D) \( \exists x. (\text{HasBeginning}(x) \land \text{HasEnd}(x)) \)

Explanation:
3) Which of the following is the proper way of expressing the statement "something wicked this way comes" in first-order logic?
   A) $\forall x. (IsWicked(x) \rightarrow ThisWayComes(x))$
   B) $\exists x. (IsWicked(x) \rightarrow ThisWayComes(x))$
   C) $\forall x. (IsWicked(x) \land ThisWayComes(x))$
   D) $\exists x. (IsWicked(x) \land ThisWayComes(x))$

   Explanation:

Lecture 05: First-Order Logic, Part II

4) Which of the following is a negation of the first-order logic formula
   $\forall x. (P(x) \rightarrow \exists y. (Q(y) \land R(x, y)))$?

   (It's a good idea to work through the Guide to Negations before doing this problem.)

   A) $\forall x. (P(x) \land \exists y. (Q(y) \rightarrow \neg R(x, y)))$
   B) $\forall x. (\neg P(x) \rightarrow \exists y. (\neg Q(y) \land \neg R(x, y)))$
   C) $\exists x. (P(x) \land \forall y. (Q(y) \rightarrow \neg R(x, y)))$
   D) $\exists x. (\neg P(x) \land \forall y. (\neg Q(y) \rightarrow \neg R(x, y)))$

   As an explanation, please show each step of the negation:

5) Which of the following is a correct translation of the statement "every turtle stands on top of another turtle," assuming $Atop(x, y)$ means that $x$ stands on top of $y$?
   A) $\exists t. (Turtle(t) \land \forall v. (Turtle(v) \land Atop(v, t)))$
   B) $\forall t. (Turtle(t) \rightarrow \exists v. (Turtle(v) \land Atop(t, v)))$
   C) $\exists t. (Turtle(t) \land \forall v. (Turtle(v) \land Atop(v, t) \land t \neq v))$
   D) $\forall t. (Turtle(t) \rightarrow \exists v. (Turtle(v) \land Atop(t, v) \land t \neq v))$

   Explanation: