Quiz Questions: Predicate Logic

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1. Which of the following is the negation of $\forall x\ (P(x) \rightarrow Q(x))$?
   A. $\exists x(P(x) \rightarrow Q(x))$
   B. $\exists x(P(x)\ \wedge \neg Q(x))$
   C. $\exists x(\neg P(x) \rightarrow \neg Q(x))$
   D. $\exists x(\neg P(x)\ \wedge\ Q(x))$

2. The negation of $\forall x \exists y \forall z\ Q(x, y, z)$ is:
   A. $\neg\ (\forall x \exists y \forall z\ \neg Q(x, y, z))$
   B. $\exists x \forall y \exists z\ \neg Q(x, y, z)$
   C. $\forall x \exists y \forall z\ \neg Q(x, y, z)$

3. Which of these statements says that "Every number has exactly one additive inverse."? Assume that the universe for all variables consists of all real numbers
   A. $\forall x\ \exists y\ \forall z\ [(x + y = 0)\ \wedge\ ((x + z = 0) \rightarrow (y = z))]$
   B. $\forall x \forall y \exists z(x + y = x + z = 0)$
   C. $\forall x\ \exists y(x\ + y = 0)$
   D. $\forall x \exists y \exists z[(x + y = 0)\ \wedge\ (x + z = 0)]$

4. Which of these statements is the negation of the following statement

$$\forall x \exists y(P(x, y)\ \wedge\ (\exists z\ R(x, y, z)))$$

   A. $\forall x \exists y(\neg P(x, y)\ \vee\ \exists z(\neg R(x, y, z)))$
   B. $\exists x \forall y(\neg P(x, y)\ \vee\ \forall z(\neg R(x, y, z)))$
   C. $\exists x \forall y(P(x, y)\ \vee\ \forall z R(x, y, z))$
   D. $\forall x \exists y(P(x, y)\ \wedge\ \forall z(\neg R(x, y, z)))$

5. The statement," Every comedian is funny" where $C(x)$ is "x is a comedian" and $F(x)$ is "x is funny" and the domain consists of all people.
   A. $\exists x(C(x)\ \wedge\ F\ (x))$
   B. $\forall x(C(x)\ \wedge\ F\ (x))$
   C. $\exists x(C(x)\ \rightarrow\ F\ (x))$
   D. $\forall x(C(x)\ \rightarrow\ F\ (x))$

6. Let the domain of m includes all students, $P(m)$ be the statement "m spends more than 2 hours in playing polo". Express $\forall m\ \neg P\ (m)$ quantification in English.
   A. A student is there who spends more than 2 hours in playing polo
   B. There is a student who does not spend more than 2 hours in playing polo
   C. All students spends more than 2 hours in playing polo
   D. No student spends more than 2 hours in playing polo

7. When saying:
   If x and y are real numbers, then $|x\ +\ y\ |\ \leq\ |x\ |\ +\ |y\ |$.
   What quantifiers on the two variables are meant?
   A. $\forall x\ \forall y$, where the universe for x and y is the set of all real numbers.
   B. $\exists x\ \exists y$, where the universe for x and y is the set of all real numbers.
   C. $\forall x\ \exists y$, where the universe for x and y is the set of all real numbers.
   D. $\exists x\ \forall y$, where the universe for x and y is the set of all real numbers.

8. Which of the following is the negation of the statement: “Everyone in the class except Lee has a computer”.
    A. Someone in the class other than Lee does not have a laptop computer or Lee has a laptop computer
    B. Lee and someone else in the class have a laptop computer
    C. Lee is the only student in the class with a laptop computer
    D. Someone in the class other than Lee does not have a laptop computer and Lee does not have a laptop computer