Names: ________________________________

Solutions are to be written on the board.

1. Translate these statements into (grammatical!) English, where \( C(x) \): “\( x \) is a comedian,” \( F(x) \): “\( x \) is funny”, and the domain of discourse is all people.

(a) \( \forall x (C(x) \rightarrow F(x)) \)
(b) \( \forall x (C(x) \land F(x)) \)
(c) \( \exists x (C(x) \rightarrow F(x)) \)
(d) \( \exists x (C(x) \land F(x)) \)

2. Rewrite each of the following statements so that negations appear only within predicates (that is, so that no negation is outside a quantifier or an expression involving logical connectives.) Recall that \( \sim P \) and \( \overline{P} \) mean the same thing.

(a) \( \sim \forall x \forall y P(x,y) \)
(b) \( \sim \forall y \exists x P(x,y) \)
(c) \( \sim \forall y \forall y (P(x,y) \lor Q(x,y)) \)
(d) \( \sim (\exists x \exists y \sim P(x,y) \land \forall x \forall y Q(x,y)) \)
(e) \( \sim \forall x (\exists y \forall z P(x,y,z) \land \exists z \forall y P(x,y,z)) \)

3. Let \( F(x,y) \) be the predicate “\( x \) can fool \( y \)” where the domain of discourse is the set of all people in the world. Express each of these statements using logical quantifiers.

(a) Nobody can fool everybody.
(b) Somebody cannot be fooled by anybody.
(c) Everybody can fool somebody.
(d) There is no one who can fool everybody.
(e) Everyone can be fooled by somebody.
(f) There is somebody who can be fooled by everybody.