a) We want to assert that \( P(x) \) is true for some \( x \) in the domain, so either \( P(-1) \) is true or \( P(3) \) is true or \( P(5) \) is true. Thus the answer is \( P(-1) \lor P(3) \lor P(5) \).

b) \( P(-5) \land P(-3) \land P(-1) \land P(1) \land P(3) \land P(5) \)

c) The formal translation is as follows: \( ((-5 \neq 1) \rightarrow P(-5)) \land ((-3 \neq 1) \rightarrow P(-3)) \land ((-1 \neq 1) \rightarrow P(-1)) \land ((1 \neq 1) \rightarrow P(1)) \land ((3 \neq 1) \rightarrow P(3)) \land ((5 \neq 1) \rightarrow P(5)) \). However, since the hypothesis \( x \neq 1 \) is false when \( x \) is 1 and true when \( x \) is anything other than 1, we have more simply \( P(-5) \land P(-3) \land P(-1) \land P(3) \land P(5) \).

d) The formal translation is as follows: \( ((-5 \leq 0) \land P(-5)) \lor ((-3 \leq 0) \land P(-3)) \lor ((-1 \leq 0) \land P(-1)) \lor ((1 \leq 0) \land P(1)) \lor ((3 \leq 0) \land P(3)) \lor ((5 \leq 0) \land P(5)) \). Since only three of the \( x \)'s in the domain meet the condition, the answer is equivalent to \( P(1) \lor P(3) \lor P(5) \).

e) For the second part we again restrict the domain: \( \neg P(-5) \lor \neg P(-3) \lor \neg P(-1) \lor \neg P(1) \lor \neg P(3) \lor \neg P(5) \lor P(-1) \land P(-3) \land P(-5) \). This is equivalent to \( \neg P(1) \lor \neg P(3) \lor \neg P(5) \lor P(-1) \land P(-3) \land P(-5) \).

22. Many answer are possible in each case.

a) A domain consisting of a few adults in certain parts of India would make this true. If the domain were all residents of the United States, then this is certainly false.

b) If the domain is all residents of the United States, then this is true. If the domain is the set of pupils in a first grade class, it is false.

c) If the domain consists of all the United States Presidents whose last name is Bush, then the statement is true. If the domain consists of all United States Presidents, then the statement is false.

d) If the domain were all residents of the United States, then this is certainly true. If the domain consists of all babies born in the last five minutes, one would expect the statement to be false (it’s not even clear that these babies “know” their mothers yet).

24. In order to do the translation the second way, we let \( C(x) \) be the propositional function “\( x \) is in your class.” Note that for the second way, we always want to use conditional statements with universal quantifiers and conjunctions with existential quantifiers.

a) Let \( P(x) \) be “\( x \) has a cellular phone.” Then we have \( \forall x P(x) \) the first way, or \( \exists x (C(x) \rightarrow P(x)) \) the second way.

b) Let \( F(x) \) be “\( x \) has seen a foreign movie.” Then we have \( \exists x F(x) \) the first way, or \( \exists x (C(x) \land F(x)) \) the second way.

c) Let \( S(x) \) be “\( x \) can swim.” Then we have \( \exists x \neg S(x) \) the first way, or \( \exists x (C(x) \land \neg S(x)) \) the second way.

d) Let \( Q(x) \) be “\( x \) can solve quadratic equations.” Then we have \( \forall x Q(x) \) the first way, or \( \forall x (C(x) \rightarrow Q(x)) \) the second way.

e) Let \( R(x) \) be “\( x \) wants to be rich.” Then we have \( \exists x \neg R(x) \) the first way, or \( \exists x (C(x) \land \neg R(x)) \) the second way.

26. In all of these, we will let \( Y(x) \) be the propositional function that \( x \) is in your school or class, as appropriate.

a) If we let \( U(x) \) be “\( x \) has visited Uzbekistan,” then we have \( \exists x U(x) \) if the domain is just your schoolmates, or \( \exists x (Y(x) \land U(x)) \) if the domain is all people. If we let \( V(x, y) \) mean that person \( x \) has visited country \( y \), then we can rewrite this last one as \( \exists x (Y(x) \land V(x, \text{Uzbekistan})) \).

b) If we let \( C(x) \) and \( P(x) \) be the propositional functions asserting that \( x \) has studied calculus and C++, respectively, then we have \( \forall x (C(x) \land P(x)) \) if the domain is just your schoolmates, or \( \forall x (Y(x) \rightarrow (C(x) \land P(x))) \) if the domain is all people. If we let \( S(x, y) \) mean that person \( x \) has studied subject \( y \), then we can rewrite this last one as \( \forall x (Y(x) \rightarrow (S(x, \text{calculus}) \land S(x, \text{C++}))) \).

c) If we let \( B(x) \) and \( M(x) \) be the propositional functions asserting that \( x \) owns a bicycle and a motorcycle, respectively, then we have \( \forall x (\neg (B(x) \land M(x))) \) if the domain is just your schoolmates, or \( \forall x (Y(x) \rightarrow \neg (B(x) \land M(x))) \) if the domain is all people.