PROBLEM 1 Symbolizing

For each of the following, convert from text to symbolic logic. Some are known, named truths (we included the name for fun); others are false. The first one is done for you.

**Celarent**  No G are F. All H are G. So: No H are F

\[ \exists x . G(x) \land F(x) \quad \text{or} \quad \forall x . G(x) \rightarrow \neg F(x), \text{ or } \forall x . \neg (G(x) \land F(x)), \text{ or equivalent} \]

\[ \forall x . H(x) \rightarrow G(x) \]

\[ \therefore \exists x . H(x) \land F(x) \quad \text{or equivalent} \]

**Barbara**  All G are F. All H are G. So: All H are F

\[ \forall x . G(x) \rightarrow F(x) \]

\[ \forall x . H(x) \rightarrow G(x) \]

\[ \therefore \forall x . H(x) \rightarrow F(x) \]

**Ferio**  No G are F. Some H is G. So: Some H is not F

\[ \exists x . G(x) \land F(x) \]

\[ \exists x . H(x) \land G(x) \]

\[ \therefore \exists x . H(x) \land \neg F(x) \]

**(false)**  All G are F. No H is not G. So: Some H is not F

\[ \forall x . G(x) \rightarrow F(x) \]

\[ \exists x . H(x) \land \neg G(x) \]

\[ \therefore \exists x . H(x) \land \neg F(x) \]

Want more practice? Try Practice exercises \( \forall x \) 22.A (pages 187–188)
PROBLEM 2 Symbolizing with a Key

Using this symbolization key:

domain: all animals

\( A(x) \): is an alligator
\( M(x) \): is a monkey
\( Z(x) \): lives at the zoo
\( L(x, y) \): loves

\( a \): Artist
\( b \): Bouncer
\( c \): Champion

 Symbolize each of the following sentences; the first one is done for you.

If both Bouncer and Champion are alligators, then Artist loves them both.

\[
( A(b) \land A(c) ) \rightarrow ( L(a, b) \land L(a, c) )
\]

Any animal that lives at the zoo is either a monkey or an alligator.

\[
\forall x . Z(x) \rightarrow ( M(x) \lor A(x) )
\]

Champion loves a monkey.

\[
\exists x . M(x) \land L(c, x)
\]

All the monkeys that Artist loves love Artist.

\[
\forall x . ( L(a, x) \land M(x) ) \rightarrow L(x, a)
\]

Everyone Bouncer loves loves some animal other than Bouncer.

\[
\forall x . L(b, x) \rightarrow ( \exists y . ( y \neq b ) \land L(x, y) )
\]

Every animal in the zoo’s love is outside the zoo, and vice versa.

\[
\forall x, y . L(x, y) \rightarrow ( Z(x) \oplus Z(y) )
\]

Want more practice? Try Practice exercises \( \forall x \ 22.B \) (page 188) and \( \forall x \ 23.A–F \) (pages 199–203).