

**Exercises in Existential Quantification**  
PHI 154 (Eliot)

**domain** : people

$F(x)$  : \_\_\_\_\_ $_x$  is famous

$P(x)$  : \_\_\_\_\_ $_x$  is a professor

$T(x)$  : \_\_\_\_\_ $_x$  has a television

$K(x, y)$  : \_\_\_\_\_ $_x$  knows who \_\_\_\_\_ $_y$  is

$j$  : Joe Biden

$k$  : Kim Kardashian

$d$  : Doris (who cooks at Bits & Bytes)

Translate these from First-order Logic into English using the provided key. Think about them literally first, and then think whether there is a more natural way to express them in English:

1.  $F(k) \wedge F(j)$
2.  $T(k) \wedge F(k)$
3.  $\neg P(k) \wedge K(k, j)$
4.  $K(j, k) \rightarrow \neg P(k)$
5.  $K(k, k) \wedge \neg K(j, j)$
6.  $\neg F(d) \wedge \neg(K(j, d) \vee K(k, d))$
7.  $K(j, k) \leftrightarrow T(j)$
8.  $\exists x \neg F(x)$
9.  $\neg \exists x F(x)$
10.  $\neg \exists y \neg T(y)$
11.  $\exists z (P(z) \wedge \neg F(z))$
12.  $\exists z \neg (P(z) \wedge F(z))$
13.  $\neg \exists z (P(z) \wedge F(z))$
14.  $\exists y F(y) \wedge \exists x P(x)$
15.  $\exists x K(x, j) \rightarrow K(d, j)$
16.  $\exists x \neg K(d, x) \wedge K(d, k)$
17.  $\exists x (P(x) \wedge \neg K(x, k))$
18.  $\exists x (\neg K(x, k) \wedge P(x))$
19.  $\neg \exists y (P(y) \wedge (\neg T(y) \wedge \neg K(y, k)))$
20.  $\neg \exists z \neg (P(z) \vee T(z))$
21.  $[\exists x \neg T(x) \rightarrow \exists y \neg K(y, j)] \wedge [\exists y \neg K(y, j) \rightarrow \exists z \neg K(z, k)]$
22.  $\neg \exists x \neg T(x) \rightarrow \neg \exists y (\neg K(y, j) \wedge \neg K(y, k))$
23.  $\neg \exists x \neg K(x, j) \vee [\exists x \neg K(x, j) \rightarrow \neg \exists y T(y)]$

24.  $\exists y[P(y) \wedge (K(y, k) \leftrightarrow T(y))]$
25.  $\exists y[(F(y) \wedge P(y)) \wedge [(T(y) \vee \neg T(y)) \rightarrow K(y, k)]]$
26.  $\exists z(K(z, d) \wedge K(z, k)) \rightarrow \exists y(P(y) \wedge T(y))$

Translate from English into First-order Logic:

1. Doris isn't famous, but Kim Kardashian is.
2. Kim Kardashian is famous, but she is not a famous professor.
3. Kim Kardashian is famous if and only if Joe Biden is.
4. Though Doris isn't famous, someone is.
5. Someone is famous and they have a TV.
6. Kim Kardashian is famous only if someone has a TV.
7. Nobody is famous.
8. Somebody is not famous.
9. No one isn't famous.
10. Someone is neither famous nor a professor.
11. Someone is a non-famous professor only if someone is not famous.
12. There are no non-famous professors who own televisions.
13. Someone isn't a professor and isn't famous, but knows Kim Kardashian.
14. If Kim Kardashian doesn't know who she is, she doesn't have a TV or she's not famous.
15. If no one is famous and no one owns a TV, no one knows who Kim Kardashian is.
16. Someone who doesn't have a TV is a famous professor.
17. If there's a professor who doesn't have a TV, there's someone who doesn't know who Kim Kardashian is.
18. If Joe Biden doesn't know who Doris is, then at least some professors do.
19. There are no professors who don't know who Joe Biden is.
20. Some professors don't know who Kim Kardashian is just in case some professors neither have televisions nor know who Joe Biden is.
21. If Joe Biden knows who Kim Kardashian is, then there's nobody who doesn't know who Kim Kardashian is.
22. There's a famous professor who knows who both Kim Kardashian and Joe Biden are if and only if there's a famous professor who has a television.