

#21 (a, f) p. 54

a. There are some women lawyers who are chemists.

$$(\exists x) [W(x) \wedge L(x) \wedge C(x)]$$

f. All women lawyers admire some judge.

$$(\forall x) [W(x) \wedge L(x) \rightarrow (\exists y) [J(y) \wedge A(x, y)]]$$

#36 (a, c) Decide whether invalid or not:

a. $(\forall x) A(x) \rightarrow ((\exists x) [A(x)]')'$ Valid

"Double negation" $((\exists x) [A(x)]')' \leftrightarrow (\forall x) ([A(x)]')$
"negation of quantifiers" $\leftrightarrow (\forall x) A(x)$

c. $(\forall x) [P(x) \vee Q(x)] \rightarrow (\forall x) P(x) \vee (\exists x) Q(x)$

Everything in the domain has property P or Q. Suppose something does not have P; then it must have Q. So if

$(\forall x) P(x)$ fails, we will have

$$(\exists x) Q(x).$$

We'll have one or the other.

(therefor) $(\forall x) P(x) \vee (\exists x) Q(x)$. Valid.

#13 p 51 (b, f, j)

b. Some days are not rainy.

$$(\exists x) [D(x) \wedge \neg R(x)] \quad \text{J and A}$$

f. If it is always a sunny day only if it is a rainy day

$$(\forall x) [D(x) \wedge S(x) \rightarrow R(x)] \quad *$$

j. If some day is rainy, then every day will be sunny.

$$(\exists x) [D(x) \wedge R(x)] \rightarrow (\forall x) [D(x) \rightarrow S(x)]$$