

c. $(a \rightarrow \neg b) \wedge (a \wedge b)$ is a contradiction.

- ① $(\neg a \vee \neg b) \wedge (a \wedge b)$ Def. of Implication
- ② $((\neg a \vee \neg b) \wedge a) \wedge b$ Associative Law
- ③ $((\neg a \wedge a) \vee (\neg b \wedge a)) \wedge b$ Distributive Law
- ④ $(F \vee (\neg b \wedge a)) \wedge b$ Trivial contradiction
- ⑤ $(\neg b \wedge a) \wedge b$ Identity Law
- ⑥ $(\neg b \wedge (a \wedge b))$ Associative Law
- ⑦ $(\neg b \wedge (b \wedge a))$ Commutative Law
- ⑧ $(\neg b \wedge b) \wedge a$ Associative Law
- ⑨ $F \wedge a$ Trivial Contradiction
- ⑩ F Domination

4. $x \in \{\text{lollipops, pies, danishes}\}$

$y \in \{\text{apple, cherry, grape, banana}\}$

$T(x,y) = \text{"x are available in y flavor"}$

Assume that:

Lollipops are available in apple, cherry, grape, and banana flavors.

Pies and danishes are available only in apple and cherry flavors.

Which of the following statements are true:

- a. $\forall x \forall y T(x,y)$ F
- b. $\neg \forall x \forall y T(x,y)$ T
- c. $\forall x \neg \forall y T(x,y)$ F
- d. $\exists x \exists y T(x,y)$ T
- e. $\neg \exists x \exists y T(x,y)$ F
- f. $\exists x \neg \exists y T(x,y)$ F
- g. $\exists y \neg \exists x T(x,y)$ F
- h. $\forall y \exists x T(x,y)$ T
- i. $\exists y \neg \forall x T(x,y)$ T