1) formas.

- $\neg pompeano(x) \vee romano(x)$
- $\neg romano(x) \vee leal(x, c) \vee odeia(x, c)$
- $leal(x, f(x))$
- $\neg homem(x) \vee \neg soberano(y) \vee \neg tentaA(x, y) \vee \neg leal(x, y)$

axiomas.

- $homem(M)$
- $pompeano(M)$
- $soberano(c)$
- $tentaA(M, c)$

$w = odeia(M, c)$

$\neg odeia(M, C) \mid \neg romano(M) \vee leal(M, C) \vee odeia(M, C)$

$\neg romano(M) \vee leal(M, C) \mid romano(M)$

$leal(M, C) \mid \neg homem(M) \vee \neg soberano(C) \vee \neg tentaA(M, C) \vee leal(x, y)$

$\neg homem(M) \vee \neg soberano(C) \vee \neg tentaA(M, C) \mid homem(M)$

$\neg soberano(C) \vee \neg tentaA(M, C) \mid soberano(C)$

$\neg tentaA(M, C) \mid tentaA(M, C)$

□

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2) a) $\neg[(P \wedge (\neg Q \vee R)) \rightarrow ((P \wedge \neg Q) \vee (P \wedge R))]$

$\neg[\neg(P \wedge (\neg Q \vee R)) \vee ((P \wedge \neg Q) \vee (P \wedge R))]$
$\neg[\neg P \vee \neg(\neg Q \vee R) \vee ((P \wedge \neg Q) \vee (P \wedge R))]$
$\neg[\neg P \vee (Q \wedge \neg R) \vee (P \wedge (\neg Q \vee R))]$
$\neg[((\neg P \vee Q) \wedge (\neg P \vee \neg R)) \wedge \neg((P \wedge \neg Q) \vee (P \wedge R))]$
$\neg((\neg P \vee Q) \wedge \neg(P \vee \neg R)) \wedge \neg((P \wedge \neg Q) \vee (P \wedge R))$
$\neg(\neg P \vee Q) \vee \neg(\neg P \vee \neg R) \wedge \neg(P \wedge \neg Q) \wedge \neg(P \wedge R)$
$((P \wedge \neg Q) \vee (P \wedge R)) \wedge (\neg P \vee Q) \wedge (\neg P \vee R)$

b) $\exists x \forall y P(x, y) \rightarrow \forall y \exists x P(x, y)$

$\neg(\exists x \forall y P(x, y) \rightarrow \forall y \exists x P(x, y))$
$\neg(\neg(\exists x \forall y P(x, y)) \vee \forall y \exists x P(x, y))$
$\neg(\neg(\forall y P(a, y)) \vee P(x, f(x)))$
$\neg(\neg \forall y P(a, y)) \vee P(x, f(x)))$
$\neg\neg \forall y P(a, y) \wedge \neg P(x, f(x)))$
$\forall y P(a, y) \wedge \neg P(x, f(x))$
$P \wedge \neg P$

c) $\neg(\exists x P(x) \wedge Q(x)) \rightarrow (\exists x P(x) \wedge \exists x Q(x)))$

$\neg(\neg(\exists x P(x) \wedge Q(x)) \vee (\exists x P(x) \wedge \exists x Q(x)))$
$\neg((\neg \exists x P(x) \vee \neg Q(x)) \vee (\exists x P(x) \wedge \exists x Q(x)))$
$\neg((\neg P(x) \vee \neg Q(x)) \vee (\exists x P(x) \wedge \exists x Q(x)))$
$\neg(\neg P(x) \vee \neg Q(x)) \wedge (\neg \exists x P(x) \vee \neg \exists x Q(x))$
$(P(x) \wedge Q(x)) \wedge (\neg \exists x P(x) \vee \neg \exists x Q(x))$
$(P(x) \wedge Q(x)) \wedge \neg P(x) \wedge \neg Q(x)$

3) a) $\neg((P \wedge \neg Q) \rightarrow \neg(P \rightarrow Q))$

$\neg(\neg(P \wedge \neg Q) \vee \neg(P \rightarrow Q))$

$\neg(\neg(P \wedge \neg Q) \vee \neg(\neg P \vee Q))$

$(\neg\neg(P \wedge \neg Q) \wedge \neg\neg(\neg P \vee Q))$

$(P \wedge \neg Q) \wedge (\neg P \vee Q)$

$P \wedge \neg Q \wedge (\neg P \vee Q)$

Tableaux:

$\neg((P \wedge \neg Q) \rightarrow \neg(P \rightarrow Q))$

$(P \wedge \neg Q)$

$\neg(\neg(P \rightarrow Q))$

P

$\neg Q$

$(P \rightarrow Q)$

$\neg P \quad | \quad Q$

b) $\neg(\exists x\,(P(x) \wedge Q(x)) \rightarrow (\exists x\,P(x) \wedge \exists x\,Q(x)))$

$\neg(\neg(\exists x\,(P(x) \wedge Q(x)) \vee (\exists x\,P(x) \wedge \exists x\,Q(x)))$

$\neg\neg(\exists x\,(P(x) \wedge Q(x)) \wedge \neg(\exists x\,P(x) \wedge \exists x\,Q(x)))$

$\exists x\,(P(x) \wedge Q(x)) \wedge (\neg P(x) \vee \neg Q(x))$

$\exists x\,P(x) \wedge \exists x\,Q(x) \wedge (\neg P(x) \vee \neg Q(x))$

Tableaux:

$\neg(\exists x\,(P(x) \wedge Q(x)) \rightarrow (\exists x\,P(x) \wedge \exists x\,Q(x)))$

$\exists x\,(P(x) \wedge Q(x))$

$\neg(\exists x\,P(x) \wedge \exists x\,Q(x))$

$(P(a) \wedge Q(a))$

$\neg\exists x\,Px \vee \neg\exists x\,Q(x)$

$P(a)$

$Q(a)$

$\neg\exists x\,P(x) \quad | \quad \neg\exists x\,Q(x)$

$\neg P(a) \quad | \quad \neg Q(a)$

c) $\neg(\forall x(P(x) \vee Q(x)) \rightarrow (\exists x P(x) \vee \forall x Q(x)))$

$\neg(\neg(\forall x(P(x) \vee Q(x))) \vee (\exists x P(x) \vee \forall x Q(x)))$

$\neg(\neg\forall x P(x) \wedge \neg Q(x)) \vee (\exists x P(x) \vee \forall x Q(x))$

$\neg\neg\forall x P(x) \vee \neg\neg Q(x) \wedge \neg(\exists x P(x) \vee \forall x Q(x)))$

$\forall x P(x) \vee Q(x)) \wedge \neg\exists x P(x) \wedge \neg\forall x Q(x)$

Tableaux:

$\neg(\forall x (P(x) \vee Q(x)) \rightarrow (\exists x P(x) \vee \forall x Q(x)))$

$\forall x (P(x) \vee Q(x))$

$\neg(\exists x P(x) \vee \forall x Q(x))$

$P(x) \vee Q(x)$

$\neg\exists x P(x)$

$\neg\forall x Q(x)$

$\neg P(x)$

$\neg Q(x)$ ✗

$P(x)$

$Q(x)$