① p   premissa

② p → u   premissa

③ u   MP(1,2)

④ p ∧ q → ¬u   premissa

⑤ $\boxed{p \land q}$ ipotesi

⑥ ¬u   (→e) (4, 5)

⑦ p   ∧e 5

⑧ q   ∧e 5

⑨ ⊥   ¬e 3,6

⑩ ¬(p ∧ q)   ¬i 5-9

⑪ ¬p ∨ ¬q

⑫ $\boxed{\begin{array}{c}¬p \\ ⊥\end{array}}$ ipotesi   ¬ 12,1

⑬ ¬q ⇒ q = fals

⑭ q → ¬∧

$$\forall x \, (\exists y \, A(x,y) \land \forall y \, \neg B(x,y) \to \neg (\exists z \, A(x,y) \land C(z)))$$

$$\forall x \, (\exists y \, A(x,y) \land \forall z \, \neg B(x,z) \to \neg (\exists p \, A(x,p) \land C(z)))$$

$$\forall x \, (\exists y \, A(x,y) \land \neg(\forall z \, \neg B(x,z)) \lor \neg (\exists p \, A(x,p) \land C(z)))$$

$$\forall x \, (\exists y \, A(x,y) \land \exists z \, B(x,z) \lor \forall p \, \neg A(x,p) \lor \neg C(z))$$

$$\forall x \, \exists y \, \exists z \, \forall p \, (A(x,y) \land B(x,z) \lor \neg A(x,p) \lor \neg C(z))$$

$\uparrow$ pranix

$$y \to f(x)$$
$$z \to g(x)$$

$$\forall x \, \forall p \, (A(x,f(x)) \land B(x,g(x)) \lor \neg A(x,p) \lor \neg C(z))$$

$\uparrow$

skolem

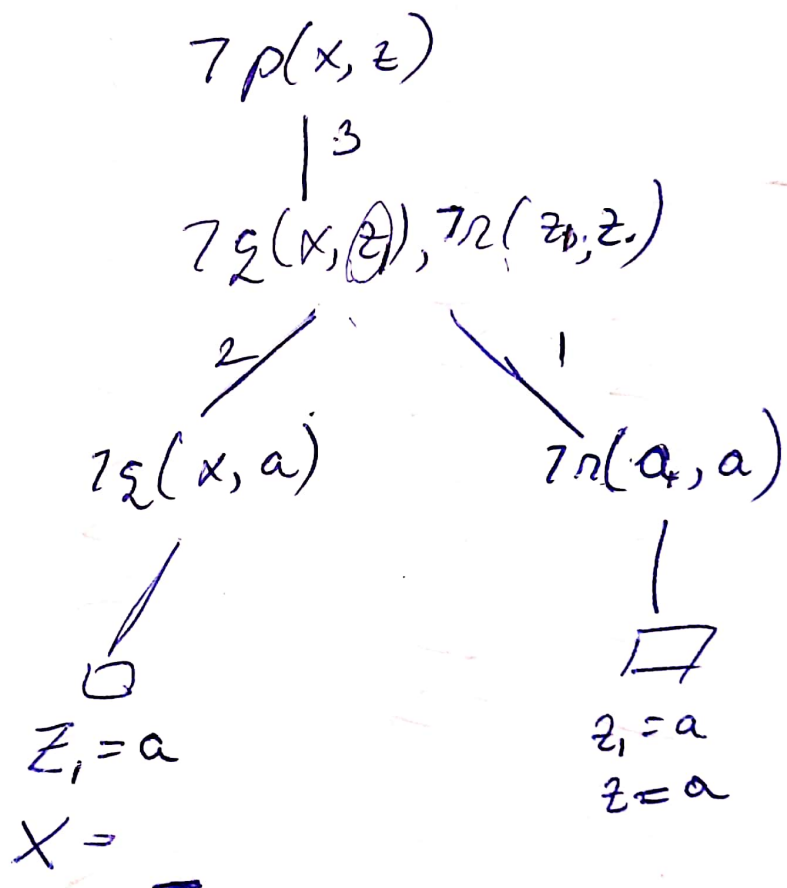| S	R	
$\varnothing$	$g(x, f(x), f(a), v) = g(h(y,v),$ $= g(h(y,v), f(h(z,u)), z, f(z))$	Initial
	$x = h(y,v)$ $f(x) = f(h(z,u))$ $f(a) = z$ $v = f(z)$	Desc.
$x = h(y,v)$	$f(h(y,v)) = f(h(z,u))$ $f(a) = z$ $v = f(z)$	Rezolvă
$z = f(a)$	$f(h(y,v)) = f(h(f(a), u))$ $v = f(f(a))$	Rezolvă
$v = f(f(a))$	$f(h(y, f(f(a)))) =$ $= f(h(f(a), u))$	Rezolvă
	$y = f(a)$ $u = f(f(a))$	Desc.
$x = h(f(a), f(f(a))$ $z = f(a)$ $v = f(f(a))$ $u = f(f(a))$ $y = f(a)$	$\varnothing$	Rezolvă

a)

1. $n(a,a)$
2. $q(x,a)$
3. $p(x,y) :- q(x,z), n(z,y)$

$? - p(x,z)$

$\neg p(x,z)$

$\Big|\, 3$

$\neg q(x,z), \neg n(z_0, z_1)$

$2 \diagup \qquad \diagdown 1$

$\neg q(x,a) \qquad\qquad \neg n(a,a)$

$\diagup \qquad\qquad\qquad\qquad \Big|$

$\square \qquad\qquad\qquad\qquad \square$

$z_1 = a \qquad\qquad\qquad z_1 = a$

$x = \underline{\quad} \qquad\qquad\qquad z = a$

P7.

(1) $\ell(d, a)$.
(2) $\ell(d, d)$.
(3) $m(a, d)$.
(4) $m(b, c)$.
(5) $p(a)$.
(6) $p(d)$
(7) $p(y) :- \ell(y, x), p(x)$

$?- p(x), m(y, x), p(y)$

$$G_0 = \neg p(x) \vee \neg m(y, x) \vee \neg p(y)$$

$$\begin{pmatrix} x = d & G_1 = \neg p(d) \vee \neg m(a, d) \vee \neg p(a) \\ y = a & G_2 = \square \end{pmatrix}$$

$x \leftarrow d \quad G_1 = \neg m(y, d) \vee \neg p(y) \quad (SLD, 6, \theta = \{x \leftarrow d\})$

$y \leftarrow a \quad G_2 = \neg m(a, d) \quad (SLD, 5, \theta = \{y \leftarrow a\})$

$SLD \ cu \ 3 \quad G_3 = \square \quad (SLD, 3)$

P8.

$?- g(c, a)$

1 (i) $g(o, a)$.
2 (ii) $g(c, a)$.
3 (iii) $g(x, z) :- g(x, y), g(y, z)$.
4 (iv) $g(x, y) :- g(y, x)$.

$\theta = \{ \}$

$G_0 = \neg g(c, a)$

$G_1 = \neg g(c, y) \vee \neg g(y, a) \quad (SLD\ 3\ \{x \leftarrow c, z \leftarrow a\})$

$G_1 = \neg g(c, y) \vee \neg g(y, a) \quad (SLD\ 2, y \leftarrow a)$

$G_2 = \neg g(c, y) \vee \neg g(a, y) \quad (SLD, 4)$

$G_3 = \neg g(a, y) \quad (SLD\ 2, \theta = \{y \leftarrow a\})$

$G_4 = \square \quad (SLD, 1, \theta = \{y \leftarrow a\})$

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1 (i) $q(a,b).$

2 (ii) $q(c,b).$

3 (iii) $q(X,Z) :- q(X,Y), q(Y,Z).$ $(q(X,Z) \lor \neg q(X,Y)) \lor \neg q(Y,Z)$

4 (iv) $q(X,Y) :- q(Y,X).$ $(q(X,Y) \lor \neg q(Y,X))$

?- $q(c,a)$

$G_0 = \neg q(c,a)$

$G_1 = \neg q(c,Y) \lor \neg q(Y,a)$ $\left(SLD, 3, \begin{array}{l} X \leftarrow c \\ Z \leftarrow a \end{array}, \theta = \{ \}\right)$

$G_2 = \neg q(c,Y) \lor \neg q(a,Y)$ $(SLD, 4)$ ~~θ = { }~~

$G_3 = \neg q(a,Y)$ $(SLD, 2, \theta = \{ Y \leftarrow b \})$

$G_4 = \square$ $(SLD, 1, \theta = \{ Y \leftarrow b \})$