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Q NO 1:

i) ~~Hassan~~ (Occupation(Jamal, surgeon) ∨ Occupation(Jamal, lawyer)

ii) Occupation(Hassan, actor) ∧ [Occupation(Hassan, Surgeon) ∨ occupation(Hassan, Doctor) ∨ occupation(Hassan, lawyer)]

iii) ∀x [Occupation(x, Surgeon) ⟹ Occupation(x, Doctor)]

iv) ∀x [~~Customer~~ Occupation(x, lawyer) ⟹ ¬Customer(Hassan, x)]

v) ∃x [Boss(x, Jamal) ∧ occupation(x, lawyer)]

vi) ∃x [Occupation(x, lawyer) ∧ (∀y (customer(y, x) ⟹ Occupation(y, doctor)))]

vii) ∀x (occupation(x, surgeon) ⟹ [∃y (occupation(y, lawyer) ∧ customer(x, y))])

Q No 2 :

i) $P(a, X)$ and $q(Y, b)$

Sol Yes possible.

$\theta \{ X/b , Y/a \}$

ii) $P(X, X)$ and $q(U, V)$

Sol

Yes Possible.

$\theta \{ U/X, V/X \}$

iii) $q(a, b, X)$ and $P(Y, Z, Y)$

Sol Yes, Possible

$\theta (Y/X, X/a, Z/b)$

iv) $P(c, Y, d, Y)$ and $P(U, U, V, V)$

Sol: No, unification is impossible

v) $P(g(a, X))$ and $P(g(U, b))$

Sol Yes, possible

$\theta \{ X/b, U/a \}$

vi) $P(f(a,b), f(x,y))$ and $P(u,u)$

Sol: yes, Possible.

$\Theta = \{x/a, y/b, u/f(a,b)\}$

vii) $P(y, f(a,y))$ and $P(g(c,d), u)$

Sol: yes, Possible.

$\Theta = \{y/g(c,d), u/f(a,g(c,d))\}$

(viii) $P(g(x,y), h(z,z))$ and $P(u, h(u,a))$

Sol: Not possible.

(ix) $P(g(x,y), g(y,z))$ and $P(u,u)$

Sol: ~~Not~~ yes, Possible.

$\Theta = \{u/g(x,y), x/y, y/z\}$

Q. No 3:-

Part A:-

(i) S(j,e)

(ii) S(p,f)

(iii) forall(X,Y,L) S(X,L) ∧ S(Y,L) => L(X,Y)

(iv) forall(W,X,Y) C(W,X) ∧ C(W,Y) => i(W,X,Y)

(v) forall(L,M) exist(X) S(X,L) ∧ S(X,M)

(vi) i(S,j,p)

Part B:-

Combining eq(3) with eq(i) and eq(1) by substituting x=m, y=j, L=e

combining (3) with (6) and (1) substituting x=m, y=p, L=f

combining (4) with (8) and (9) substituting w=m, x=y, y=p

Now (vi) can be proven from (1)(2)(3)(4)(5)

Goal G_0: i(m,j,p) match with eq(4)

symbols G_1 c(m,j). G_2: c(m,p)

Goal G_1: c(m,j) match with eq(3)
symbols G_3: S(m,L2). G_4: S(j,L2)

Goal G_3: S(m,L2) match with eq(5)
G_3 succeed
Goal G_4: S(j,e) match eq(1)
G_4 succeed

G_1 succeed
Goal G_2: c(m,p) match eq(3)
symbols G_5: S(m,L3) ∴ G_6: (S(p,L3))

Goal G_5: S(m,L3) match eq(5)
G_5 succeed
subgoal: G_6: S(p,c) No match
return to G_5

Goal to G_6: S(m,L3) match with eq(6)
G_5 succeed
subgal: G_6: S(p,f) mach eq(2)

G_6 succeed
G_2 succeed
G_0 succeed.

Q. No 4:

Rule 1:

$$Dog(X) \wedge Owns(Jack, X)$$

Rule 2:

$$\forall x: (\neg \exists y\, Dog(y) \wedge Owns(x,y)) \vee AnimalLover(x)$$

$$\forall x: (\forall y \neg Dog(y) \vee \neg Owns(x,y)) \vee AnimalLovers(X)$$

To proof: Did curiosity killed the cat?