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Excercise-7.2

Ans: 1. For any sentence **α** that has ground term **g,** and for any variable v not occuring in **α** we have,

$$\frac{\alpha}{\exists v \, Subs_1(\{g/v\}, \alpha)}$$

Where $Subs_1$ is a function that substitutes a single occuence of g with v.
Likes (Jerry, Ice Cream) - ∃x likes(x, Ice Cream)
∀x Likes(x, Ice Cream) is equivalent to ¬∃x¬ Likes(x, Ice Cream)
Now, ∀ is really a conjunction over the universe of objects and ∃ is a disjuction. So from DeMorgan's rules for quantified and unquantified sentences:
∀x¬P ≡ ¬∃xP
¬∀xP ≡ ∃x¬P
∀xP ≡ ¬∀x¬P
A universally quantified sentence can be replaced by set of all possible instantiations.
So we can write general inference rule, as

$$\frac{P(k) \text{ for some } k}{\exists x \, P(x)}$$

Ans: 2(a). We have:
S_o = {P(A,B,B) ; P(X,Y,Z)}
following progressive unification
substitute z with A{A/x}
S_1 = { P(A,B,B) ; P(A,y,z) }
now, substitute y with B{B/y}
S_2 = { P(A,B,B) ; P(A,B,z) }
then, substitute z with B { B/z }
S_3 = { P(A,B,B) ; P(A,B,B) } => unification successful

Unifier is { A/x , B/y , B/z }

Ans: 2(b).

We have:

S_o = Knows(Father(y), y), Knows (x, x)

following progressive unfication we have:

Knows(Father(y), y), Knows(Father(y), Father(y)) : {x/Father(y)}

Cannot unify variable y with Father(y) as it is a term referring to variable y. Therefore cannot unify.