

**First Midterm  
Philosophy 112  
Winter 2001**

Answer the following questions in the spaces below them.

1. (7 points each) Give the substitution instance using the constant 'a' for each of the following sentences of *PL*:

a.  $(\exists x)(\exists y)(Gxy \ \& \ (\forall z)(Gzxy \supset \ Byxa))$

$(\exists y)(Gay \ \& \ (\forall z)(Gzay \supset \ Byaa))$

b.  $(\forall y)(\exists x)(\forall z)(Xxz \supset \ (Gx \equiv \ Byav))$

$(\exists x)(\forall z)(Xxz \supset \ (Gx \equiv \ Baxv))$

2. (9 points) Show all the subformulas of the following *PL* sentence:

$(\forall x)[Fxb \supset \ (\forall z)((\exists y)Gyx \vee \ (\forall w)(Fwb \ \& \ \sim(\forall y)(Gyx \ \& \ Fza)))]$

$(\forall x)[Fxb \supset \ (\forall z)((\exists y)Gyx \vee \ (\forall w)(Fwb \ \& \ \sim(\forall y)(Gyx \ \& \ Fza)))]$

$Fxb \supset \ (\forall z)((\exists y)Gyx \vee \ (\forall w)(Fwb \ \& \ \sim(\forall y)(Gyx \ \& \ Fza)))]$

$Fxb$

$(\forall z)((\exists y)Gyx \vee \ (\forall w)(Fwb \ \& \ \sim(\forall y)(Gyx \ \& \ Fza)))]$

$(\exists y)Gyx \vee \ (\forall w)(Fwb \ \& \ \sim(\forall y)(Gyx \ \& \ Fza))$

$(\exists y)Gyx$

$Gyx$

$(\forall w)(Fwb \ \& \ \sim(\forall y)(Gyx \ \& \ Fza))$

$Fwb \ \& \ \sim(\forall y)(Gyx \ \& \ Fza)$

$Fwb$

$\sim(\forall y)(Gyx \ \& \ Fza)$

$(\forall y)(Gyx \ \& \ Fza)$

$Gyx \ \& \ Fza$

$Gyx$

$Fza$

3. (7 points each) Symbolize the following sentences in *PL*, using the symbolization key provided.

UD: Everything

d: Governor Davis     $Fxy$ : x thinks y is a federal problem     $Rx$  x is right  
b: President Bush     $Sxy$  x thinks y is a state problem     $Px$ : x is a person  
e: the energy crisis

a. President Bush thinks the energy crisis is a state problem, while Governor Davis thinks it is a federal problem, and one of them is wrong.

$(Sbe \ \& \ Fde) \ \& \ \sim(Rb \ \& \ Rd)$

b. Whoever thinks the energy crisis is a state problem does not think it is a federal problem.

$(\forall x)((Px \ \& \ Sxe) \supset \sim Fxe)$

c. If someone who thinks the energy crisis is a state problem is right, then everyone who thinks it is a federal problem is wrong.

$(\exists x)((Px \ \& \ Sxe) \ \& \ Rx) \supset (\forall x)((Px \ \& \ Fxe) \supset \sim Rx)$

4. (7 points each) Symbolize the following sentences in *PLI*, using the symbolization key provided.

UD: Positive integers (1, 2, 3, . . .)

f: four    Gxy: x is greater than y

s: six    Lxy: x is less than y

a. Four, but not six, is less than or equal to four.

$(Lff \vee f = f) \ \& \ \sim(Lsf \vee s = f)$

b. There is no positive integer which is greater than every positive integer.

$\sim(\exists x)(\forall y)Gxy$

c. Exactly one positive integer is less than six and greater than four.

$(\exists x)[(Lxs \ \& \ Gxf) \ \& \ (\forall y)((Lys \ \& \ Gyf) \supset x = y)]$

5. (7 points each) Symbolize the following sentences in *PLI*, providing your own symbolization key.

Symbolization key

Sx: x is a small bus      Vx: x is an SUV      Lx: x is a large car  
Tx: x is a truck      Bx: x is a bus  
Lxy: x is larger than y      Uxy: x uses more energy than y

a. A small bus uses more energy than a large car.

$(\forall x)(Sx \supset (\forall y)(Ly \supset Uxy))$

b. Only trucks and buses are larger than SUVs.

$(\forall x)((\forall y)((Sy \ \& \ Lxy) \supset (Tx \vee Bx))$

c. Every SUV is larger than some truck, but some truck is larger than every SUV.

$(\forall x)(Vx \supset (\exists y)(Ty \ \& \ Lxy)) \ \& \ (\exists x)(Tx \ \& \ (\forall y)(Vy \supset) Lxy)$

6. (7 points each) Give fluent readings of the following sentences of *PLI*, using the symbolization key provided.

UD: Everything

f: Florida                      s: the Supreme Court     $W_{xy}$ : x wins y  
g: Al Gore                      e: the electoral vote     $F_{xyz}$ : x makes y the winner in z  
 $P_x$ : x is a person

a.  $(\sim F_{sgf} \supset \sim W_{gf}) \ \& \ (\forall x)(P_x \supset (\sim W_{xf} \supset \sim W_{xe}))$

Al Gore does not win Florida unless the Supreme Court makes him a winner there, and anyone who does not win Florida does not win the electoral vote.

b.  $(\exists x)[((P_x \ \& \ F_{sxf}) \ \& \ (\forall y)(F_{syf} \supset x = y)) \ \& \ W_{xe}]$

The person the Supreme Court makes the winner in Florida wins the election.