Philosophy 109, Introduction to Modern Logic, Queens College
Russell Marcus, Instructor
email: philosophy@thatmarcusfamily.org
website: http://philosophy.thatmarcusfamily.org
Office phone: (718) 997-5287

Problems to Review for Final

I. Translations (no relational predicates or identity theory).

1. All students who attend college are educated. (Sx, Cx, Ex)
2. Men and women are adults. (Mx, Wx, Ax)
3. Lawyers are intelligent and shifty. (Lx, Ix, Sx)
4. Not all doctors are greedy. (Dx, Gx)
5. No excellent doctors are greedy. (Ex, Dx, Gx)
6. No one who attends college is ignorant. (Px, Ax, Ix)
7. Only glib politicians can be elected. (Gx, Px, Ex)
8. No one can be elected unless someone is nominated. (Px, Ex, Nx)
9. Some people lie and some people cheat. (Px, Lx, Cx)
10. Either everyone is mortal or no one is. (Px, Mx)

II. Derivations.

1)
1. Ab ∨ Bc
2. (x)~Bx / (∃x)Ax

2)
1. (x)(Rx ⊃ Ox)
2. (∃x)~Ox
3. (x)(~Rx ⊃ Px) / (∃x)Px

3)
1. (x)(Fx ⊃ Gx)
2. (y)(Gy ⊃ Hy) / (z)(~Hz ⊃ ~Fz)

4)
1. (∃x)(Ax · Bx) ⊃ (x) Dx
2. ~Da / (x)(Ax ⊃ ~Bx)

5)
1. (y)[Ay ⊃ (~By ⊃ Dy)]
2. ~Ba / Aa ⊃ Da

6)
1. (x)(Qx ⊃ ~Px) / (∃x)Px ⊃ ~(x)Qx

7)
1. (x)[Ax ⊃ (Bx · Dx)]
2. (x)[(Ax · Dx) ⊃ Ex]
3. (x)(Ex ⊃ ~Dx) / ~Aa

8)
1. (x)(Ax ⊃ Bx)
2. (x)[Bx ⊃ (Ax ⊃ ~Fx)]
3. (x)[(~Cx · Dx) ⊃ Fx] / (x)[Ax ⊃ (Cx ∨ ~Dx)]

9)
1. (∃x)Gx ⊃ (x)(Fx ⊃ Dx)
2. (∃x)(Gx · ~Dx) / ~(x)Fx

10)
1. (∃x)Qx ⊃ (x)(Rx ⊃ Sx)
2. (x)~Qx ⊃ (∃x)Sx
3. (x) Rx / (∃x)Sx

III. Translations (including relational predicates and identity theory).

Use the given legend to translate the following sentences.

Bxy: x is a brother of y
Fx: x is a feminist
Gx: x is Greek
Mxy: x mocks y
Nx: x is a novel
Px: x is a philosopher
Rxy: x is richer than y
Sxy: x is smarter than y
Wxy: x wrote y

1. All feminists are philosophers.
2. All Greek feminists are philosophers.
3. Nietzsche mocks all feminists.
4. Nietzsche mocks everything that Plato wrote.
5. Nietzsche mocks everything smarter than him.
6. Nietzsche mocks a thing if it does not mock itself.
7. If one thing is smarter than a second, then the second is not smarter than the first.
8. If all feminist philosophers are richer than some Greek philosopher, then some Greek is smarter than all feminists.
9. Cindy's only brother is Al. Ed writes novels. Al doesn't. So, Ed isn't a brother of Cindy's.
10. If one thing is richer than a second, then the two aren't identical. So, nothing is richer than itself.
11. There are at most two things. Something other than Cindy is happy. So, there are exactly two things.
12. The brother of Cindy is happy. So, Cindy has a brother.
13. Everything is happy, except Cindy and Bud. Al is unhappy. So, Al is either Cindy or Bud.

IV. Derivations. Derive the conclusions of each of the following arguments.

1) 1. $(x)(\exists y)(\sim Fx \lor Gy)$ / $(x)Fx \supset (\exists y)Gy$

2) 1. $(x)(\exists y)Fxy \supset (x)(\exists y)Gxy$
2. $(\exists x)(y)\sim Gxy$ / $(\exists x)(y)\sim Fxy$

3) 1. $(x)[(Fx \lor Gx) \supset (Hx \cdot Kx)]$
2. $(x)\{(Hx \lor Lx) \supset [(Hx \cdot Nx) \supset Px]\}$ / $(x)[Fx \supset (Nx \supset Px)]$

4) 1. $\sim(\exists x)(Axa \cdot \sim Bxb)$
2. $\sim(\exists x)(Dxd \cdot Dbx)$
3. $(x)(Bex \supset Dxg)$ / $\sim(Aea \cdot Dgd)$

5) 1. $(x)(Ax \supset Bx)$ / $(x)[(\exists y)(Ay \cdot Cxy) \supset (\exists z)(Bz \cdot Cxz)]$

6) 1. $(\exists x)(Nx \cdot Wjx \cdot Ix)$
2. $Nc \cdot Wjc \cdot (x)[(Nx \cdot Wjx) \supset x=c]$ / Ic

7) 1. $Pa \cdot Oa \cdot (y)[(Py \cdot Oy) \supset y=a]$
2. $Pw \cdot Sw \cdot (y)[(Py \cdot Sy) \supset y=w]$
3. $(\exists x)(Px \cdot Sx \cdot Ox)$ / $a=w$

8) 1. $(\exists x)\{Mx \cdot Tx \cdot (y)[(My \cdot y\neq x) \supset Hxy]$ / $(\exists x)\{Mx \cdot Tx \cdot (y)[(My \cdot \sim Ty) \supset Hxy]\}$

9) 1. $(x)(y)(z)[(Sx \cdot Lx \cdot Sy \cdot Ly \cdot Sz \cdot Lz) \supset (x=y \vee y=z \vee x=z)]$
2. $(\exists x)(\exists y)(Sx \cdot Lx \cdot Sy \cdot Ly \cdot Rx \cdot Ry \cdot x \neq y)$
3. $(x)(Rx \supset {\sim}Cx)$ / $(Sa \cdot Ca) \supset {\sim}La$

V. Invalidity. Demonstrate the invalidity of each of the following arguments. Provide a counterexample.

1) 1. $(\exists x)(Ax \cdot {\sim}Bx)$
2. $(x)(Bx \supset Cx)$ / $(\exists x)(Ax \cdot Cx)$

2) 1. $(x)(Fx \supset Gx)$
2. $(\exists x)Fx$ / $(x)({\sim}Gx \supset {\sim}Ex)$

3) 1. $(x)[(Px \cdot Qx) \supset Rx]$
2. $(\exists x)(Qx \cdot {\sim}Rx)$
3. $(\exists x)(Px \cdot {\sim}Rx)$ / $(\exists x)({\sim}Px \cdot {\sim}Qx)$