

**Final Exam - Solutions to Extra Translations**

Translate each of the following statements into PL.

1. Someone is respected by everyone.

$Rxy = x$  respects  $y$

$$(\exists x)(\forall y)Ryx$$

2. Kilroy was here.

$Hx = x$  was here,  $k = \text{Kilroy}$

$$Hk$$

3. Onyx is a cat.

$Cx = x$  is a cat,  $o = \text{Onyx}$

$$Co$$

4. Neither Onyx nor Hypatia is fat.

$Fx = x$  is fat,  $h = \text{Hypatia}$

$$\sim (Fo \vee Fh) \text{ or } \sim Fo \& \sim Fh$$

5. Cyrano loves Roxanne.

$Lxy = x$  loves  $y$ ,  $c = \text{Cyrano}$ ,  $r = \text{Roxanne}$

$$Lcr$$

6. Philosophers dislike politicians.

$Px = x$  is a philosopher,  $Tx = x$  is a politician,  $Dxy = x$  dislikes  $y$

$$(\forall x)(Px \supset (\forall y)(Ty \supset Dxy))$$

7. Romulans are crafty, but Klingons are dangerous.

$Rx = x$  is Romulan,  $Cx = x$  is crafty,  $Kx = x$  is a Klingon,  $Dx = x$  is dangerous

$$(\forall x)(Rx \supset Cx) \& (\forall x)(Kx \supset Dx)$$

8. Christian wins Roxanne only if Cyrano helps him.

$s = \text{Christian}$ ,  $r = \text{Roxanne}$ ,  $Wxy = x$  wins  $y$ ,  $Hxy = x$  helps  $y$

$$(Wsr \supset Hcs)$$

9. Freshmen and sophomores are eligible, but juniors are not.

$Fx = x$  is a freshman,  $Sx = x$  is a sophomore,  $Jx = x$  is a junior,  $Ex = x$  is eligible

$$(\forall x)[(Fx \vee Sx) \supset Ex] \& (\forall x)(Jx \supset \sim Ex)$$

10. Everyone is taller than Desdemona.

$Txy = x$  is taller than  $y$ ,  $d = \text{Desdemona}$

$$(\forall x)Txd$$

11. If nothing is impossible, then anything is possible.

$Px = x$  is possible

$$\sim (\exists x) \sim Px \supset (\forall x) Px$$

12. Nothing works unless nothing is broken.

$Wx = x$  works,  $Bx = x$  is broken

$$\sim \sim (\exists x) Bx \supset \sim (\exists x) Wx \text{ or } \sim (\forall x) \sim Bx \supset \sim (\exists x) Wx$$

13. Professors like diligent students.

$Px = x$  is a professor,  $Dx = x$  is diligent,  $Sx = x$  is a student,  $Lxy = x$  likes  $y$

$$(\forall x)(Px \supset (\forall y)[(Dy \& Sy) \supset Lxy])$$

14. If anyone is captain, then no Vulcan is.

$Cx = x$  is a captain,  $Vx = x$  is a Vulcan

$$(\exists x)Cx \supset \sim (\exists x)(Cx \& Vx) \text{ or } (\exists x)Cx \supset (\forall x)(Vx \supset \sim Cx)$$

15. Everything is mortal or immortal and any worshipped deity is immortal.

$Mx = x$  is mortal,  $Dx = x$  is a deity,  $Wx = x$  is worshipped

$$(\forall x)(Mx \vee \sim Mx) \& (\forall x)[(Dx \& Wx) \supset \sim Mx]$$

16. Only gods are immortal only if every human is mortal.

$Gx = x$  is a god,  $Hx = x$  is human

$$(\forall x)(\sim Mx \supset Gx) \supset (\forall x)(Hx \supset Mx)$$

17. The only dangerous pets are spiders or snakes.

$Dx = x$  is dangerous,  $Px = x$  is a pet,  $Sx = x$  is a spider,  $Nx = x$  is a snake

$$(\forall x)[(Dx \& Px) \supset (Sx \vee Nx)]$$

18. No one who has survived a shipwreck is not protected by Neptune.

$Sxy = x$  survives  $y$ ,  $Wx = x$  is a shipwreck,  $Pxy = x$  is protected by  $y$ ,  $n =$  Neptune

$$\sim (\exists x)[(\exists y)(Wy \& Sxy) \& \sim Pxn] \text{ or } (\forall x)[(\exists y)(Wy \& Sxy) \supset \sim \sim Pxn]$$

19. All students like some professor who likes them.

$Sx = x$  is a student,  $Px = x$  is a professor,  $Lxy = x$  likes  $y$

$$(\forall x)[Sx \supset (\exists y)[(Py \& Lyx) \& Lxy]]$$

20. No cat wants any dog unless every dog has a mouse.

$Cx = x$  is a cat,  $Wxy = x$  wants  $y$ ,  $Dx = x$  is a dog,  $Hxy = x$  has  $y$ ,  $Mx = x$  is a mouse

$$\sim (\forall x)[Dx \supset (\exists y)(My \& Hxy)] \supset \sim (\exists x)[Cx \& (\exists y)(Dy \& Wxy)]$$

21. Every gangster is feared by some obsequious lackey.

$Gx = x$  is a gangster,  $Ox = x$  is obsequious,  $Lx = x$  is a lackey,  $Fxy = x$  fears  $y$

$$(\forall x)[Gx \supset (\exists y)[(Oy \& Ly) \supset Fyx]]$$

22. There are no unspeakable truths.

$Tx = x$  is a truth,  $Sx = x$  is speakable

$$\sim (\exists x)(Tx \& \sim Sx) \text{ or } (\forall x)(Tx \supset \sim \sim Sx)$$

23. All cows are sacred or all cows fly.  
 $Cx = x$  is a cow,  $Sx = x$  is sacred,  $Fx = x$  flies
- $$(\forall x)(Cx \supset Sx) \vee (\forall x)(Cx \supset Fx)$$
24. Anyone who lives in an apartment is a senior.  
 $Lxy = x$  lives in  $y$ ,  $Ax = x$  is an apartment,  $Sx = x$  is a senior,
- $$(\forall x)[(\exists y)(Ay \& Lxy) \supset Sx]$$
25. George does not like anyone, but everyone likes George.  
 $Lxy = x$  likes  $y$ ,  $g =$  George
- $$\sim (\exists x)Lgx \& (\forall x)Lxg$$
26. Someone who is lying hates anyone who always tells the truth.  
 $Lx = x$  is lying,  $Tx = x$  always tells the truth,  $Hxy = x$  hates  $y$
- $$(\forall x)[Lx \supset (\forall y)(Ty \supset Hxy)]$$
27. No overpaid player does not play for the Bulls.  
 $Ox = x$  is overpaid,  $Px = x$  is a player,  $Axy = x$  plays for  $y$ ,  $b =$  The Bulls
- $$\sim (\exists x)[(Ox \& Px) \& \sim Axb]$$
28. Riker is liked by no one, unless he defeats all Romulans.  
 $r =$  Riker,  $Lxy = x$  likes  $y$ ,  $Dxy = x$  defeats  $y$ ,  $Rx = x$  is a Romulan
- $$\sim (\forall x)(Rx \supset Drx) \supset \sim (\exists x)Lxr$$
29. Some students are failing every class they have, but some are not.  
 $Sx = x$  is a student,  $Fxy = x$  fails  $y$ ,  $Cx = x$  is a class,  $Hxy = x$  has  $y$
- $$(\exists x)[Sx \& (\forall y)[(Cy \& Hxy) \supset Fxy]] \& (\exists x)[Sx \& \sim (\forall y)[(Cy \& Hxy) \supset Fxy]]$$
30. Only those not beyond suspicion are lying.  
 $Bx = x$  is beyond suspicion,  $Lx = x$  is lying
- $$(\forall x)[Lx \supset \sim Bx]$$
31. If the universe began, then the universe will end.  
 $u =$  The universe,  $Bx = x$  began,  $Wx = x$  will end
- $$Bu \supset Eu$$
32. If a spy is nearby, then no one is safe.  
 $Sx = x$  is a spy,  $Nx = x$  is nearby,  $Fx = x$  is safe
- $$(\exists x)(Sx \& Nx) \supset \sim (\exists x)Fx$$
33. Every play written by Shakespeare is better than any movie.  
 $Px = x$  is a play,  $s =$  Shakespeare,  $Bxy = x$  is better than  $y$ ,  $Wxy = x$  was written by  $y$ ,  
 $Mx = x$  is a movie
- $$(\forall x)[(Px \& Wxs) \supset (\forall y)(My \supset Bxy)]$$
34. Since no electron has positive charge, nothing with positive charge is an electron.  
 $Ex = x$  is an electron,  $Px =$  has a positive charge

$$\sim (\exists x)(Ex \& Px) \supset (\forall x)(Px \supset \sim Ex)$$

35. Some pets are not cats or dogs.  
 $Px = x$  is a pet,  $Cx = x$  is a cat,  $Dx = x$  is a dog

$$(\exists x)[Px \& \sim (Cx \vee Dx)]$$

36. Only mistakes make Mike mad.  
 $Mx = x$  is a mistake,  $Dxy = x$  makes  $y$  mad,  $m = \text{mike}$

$$(\forall x)(Dxm \supset Mx)$$

37. The only rich soccer players are good athletes or obnoxious snobs.  
 $Rx = x$  is rich,  $Sx = x$  is a soccer player,  $Ax = x$  is a good athlete,  $Ox = x$  is an obnoxious snob

$$(\forall x)[(Rx \& Sx) \supset (Ax \vee Ox)]$$

38. Everything is sacred unless someone is despicable, in which case nothing is sacred.  
 $Sx = x$  is sacred,  $Dx = x$  is despicable

$$(\sim (\exists x)Dx \supset (\forall x)Sx) \& ((\exists x)Dx \supset \sim (\exists x)Sx)$$

39. No student has read every book in the library.  
 $Sx = x$  is a student,  $Bx = x$  is a book,  $Lx = x$  is in the library,  $Rxy = x$  read  $y$

$$\sim (\exists x)[Sx \& (\forall y)[(By \& Ly) \supset Rxy]]$$

40. No evil act shall go unpunished.  
 $Ex = x$  is an evil act,  $Ux = x$  shall go unpunished

$$\sim (\exists x)[Ex \& Ux] \text{ or } (\forall x)(Ex \supset \sim Ux)$$

41. Dinosaurs and birds have a common ancestor.  
 $Dx = x$  is a dinosaur,  $Bx = x$  is a bird,  $Axy = x$  is an ancestor of  $y$

$$(\forall x)(\forall y)[(Dx \& By) \supset (\exists z)(Azx \& Az y)]$$

42. Demanding professors challenge all of their students.  
 $Dx = x$  is demanding,  $Px = x$  is a professor,  $Cxy = x$  challenges  $y$ ,  $Sxy = x$  is a student of  $y$

$$(\forall x)[(Dx \& Px) \supset (\forall y)(Sxy \supset Cxy)]$$

43. Everyone who respects oneself is respected by everyone who respects someone.  
 $Rxy = x$  respects  $y$

$$(\forall x)[Rxx \supset (\forall y)((\exists z)Ryz \supset Ryx)]$$

44. Not everyone is incorruptible if and only if the only role models are corruptible.  
 $Cx = x$  is corruptible,  $Rx = x$  is a role model

$$\sim (\forall x) \sim Cx \equiv (\forall x)(Rx \supset Cx)$$

45. Bill is president and Bob is not.  
 $i = \text{Bill}$ ,  $Px = x$  is president,  $b = \text{Bob}$

$$Pi \& \sim Pb$$

46. Diligent students who study hard and like all their professors always pass.  
*Dx = x* is diligent, *Sx = x* is a student, *Tx = x* studies hard, *Lxy = x* likes *y*, *Px = x* is a professor, *Ax = x* always passes

$$(\forall x)[[(Dx \& Sx) \& Tx] \& (\forall y)(Py \supset Lxy)] \supset Ax]$$

47. No student who does not respect him or herself is respected by every student.  
*Sx = x* is a student, *Rxy = x* respects *y*

$$\sim (\exists x)[(Sx \& \sim Rxx) \& (\forall y)(Sy \supset Ryx)]$$

48. If anyone likes anyone who loves no one, then he or she loves no one too.  
*Lxy = x* likes *y*, *Vx = x* loves *y*

$$(\forall x)[(\exists y)(Lxy \& \sim (\exists z)Vyz) \supset \sim (\exists z)Lxz]$$

49. Anyone taller than Tim is taller than every basketball player shorter than the tallest jockey.  
*Txy = x* taller than *y*, *t = Tim*, *Bx = x* is a basketball player, *Sxy = x* is shorter than *y*,  
*Jx = x* is a jockey

$$(\forall x)[Txt \supset (\forall y)(By \& (\exists z)(Jz \& \sim (\exists w)(Jw \& Twz)) \& Syz) \supset Txy)]$$

50. Everyone has reached the end.  
*Rxy = x* has reached *y*, *e = the end*

$$(\forall x)Rxe$$