Submission 2.1

For problems 4-12:

(a) *Translate the argument into quantificational logic. Be sure to delineate the extensions you give to predicates and names, and write the argument (now in quantificational logic) in standard form.*

(b) *Claim whether the argument is valid or sound. In some cases, soundness will be difficult to determine, so "soundness is difficult to determine" is an appropriate answer.*

(c) *Prove that the argument is valid or invalid (as appropriate) with an informal proof.*

(d) *Prove that the argument is valid (if applicable) with a proof by natural deduction.*

4. Everything has a cause. Therefore something is the cause of everything. (Some people think St. Thomas Aquinas advocated this.) (B 183)

   (a) Cxy: x is the cause of y

   $\forall x \exists y (Cyx)$

   $\exists y \forall x (Cyx)$

   (b) This argument is invalid, and therefore unsound.

   (c) Although each thing may have a cause, they may not be the same cause. Therefore, it does not follow that all things share the same cause. For example, if A is caused by A, B is caused by A, C is caused by D, and D is caused by A, the premise is satisfied, but the conclusion is not.

5. Fred hates everyone who hates Al. Al hates everyone. So Al and Fred hate each other. (B213)

   (a) Hxy: x hates y
   a: Al
   f: Fred

   $\forall x (Hax)$
   $\forall y (Hya \rightarrow Hfy)$

   $Haf \wedge Hfa$

   (b) This argument is valid. Soundness is difficult to determine.

6. All insects in this house are large and hostile. Some insects in this house are impervious to pesticides. Thus, some large, hostile insects are impervious to pesticides. (B 213)

   (a) Lx: x is large
   Hx: x is hostile
   Px: x is impervious to pesticides

   $\forall x (Lx \wedge Hx)$
   $\exists x (Px)$

   $\exists x (Lx \wedge Hx \wedge Px)$

   (b) This argument is valid and (unfortunately) quite likely sound.

7. Some students cannot succeed at the university. All students who are bright and mature can succeed. It follows that some students are either not bright or immature. (B 213)

   (a) Sx: x can succeed
   Bx: x is bright
   Mx: x is mature

$\exists x(\neg Sx)$
$\forall x((Bx \wedge Mx) \rightarrow Sx)$

$\exists x(\neg Bx \vee \neg Mx)$

(b) This argument is valid. I would argue that it's unsound.

8. There are at least 3 pigs. So there are at least two pigs.

(a) Px: x is a pig
$\exists x \exists y \exists z(Px \wedge Py \wedge Pz \wedge (x \neq y) \wedge (x \neq z) \wedge (y \neq z))$

$\exists x \exists y(Px \wedge Py \wedge (x \neq y))$

(b) This argument is valid and sound.

9. Popeye and Olive Oyl like each other since Popeye likes everyone who likes Olive Oyl, and Olive Oyl likes everyone. (B 218)

(a) Lxy: x likes y
p: Popeye
o: Olive Oyl

$\forall x(Lxo \rightarrow Lpx)$
$\forall x(Lox)$

$Lpo \wedge Lop$

(b) This argument is valid and sound.

10. This argument is unsound, for its conclusion is false, and no sound argument has a false conclusion. (J 49)

(a) U: x is unsound
F: x has a false conclusion
a: this argument

Fa
$\forall x(Fx \rightarrow Ux)$

Ua

(b) This argument is valid. Soundness is (very) difficult to determine.

(c) The second premise states that any argument with a false conclusion is unsound. The first premise states that "this argument" has a false conclusion, so it must follow that "this argument" is unsound.

11. Everyone likes Mandy. Mandy likes nobody but Andy. Therefore Mandy and Andy are the same person. (B 238)

(a) Lxy: x likes y
m: Mandy
a: Andy

$\forall x(Lxm)$
$\forall x(x \neq a \rightarrow \neg Lmx)$

$m = a$

(b) This argument is valid and sound.

12. Everyone is afraid of Mr. Hyde. Mr. Hyde is afraid only of Dr. Jekyll. Therefore, Dr. Jekyll is Mr. Hyde. (B 234)

(a) Axy: x is afraid of y
h: Mr. Hyde
j: Dr. Jekyll

$\forall x(Axh)$
$\forall x(x \neq j \rightarrow \neg Ahx)$

$h = j$

(b) This argument is valid and sound.

For problems 13-15:

(a) *Claim whether the argument is valid or invalid.*

(b) *Prove that the argument is valid or invalid (as appropriate) with an informal proof.*

13. $$\frac{\forall x(Fx \to Gx) \quad \forall x(Fx \to Hx)}{\forall x(Gx \to Hx)} \text{ (B 204)}$$

    (a) The argument is invalid.

    (b) Let y be an instance of x such that Fy is false, Gy is true, and Hy is false. In this case, both $Fy \to Gy$ and $Fy \to Hx$ are true, but $Gy \to Hy$ is not. This means that the conclusion is not true for all x.

14. $$\frac{\forall x(Fx \to Gx)}{\forall x(\neg Gx \to \neg Fx)} \text{ (B 204)}$$

    (a) This argument is valid.

    (b) This is a contrapositive.

15. $$\frac{\neg\exists x(Fx \land Gx) \quad \forall x(Gx \to Hx)}{\forall x(Fx \to \neg Hx)} \text{ (B 204)}$$

    (a) This argument is invalid.

    (b) Let y be an instance of x such that Fy is true and Hy is true. Since Fy is true and there is no x such that both Fx and Gx are true, Gy must be false. However, this does not imply anything abuot Hy. Since this case does not pose any contradictions but renders the conclusion false, the argument is invalid.