P53 7

a) Every comedian is funny.
b) Everyone is a comedian and is funny.
c) There exists at least one person such that if he or she is a comedian, then he or she is funny.
d) There exists at least one comedian that is funny.

P54 25

Let P(x) be “x is perfect”. Let F(x) be “x is your friend”. Let the domain be all people.

a) $\forall x\ \neg P(x)$
b) $\neg \forall x\ P(x)$
c) $\forall x\ (F(x) \rightarrow P(x))$
d) $\exists x\ (F(x) \wedge P(x))$
e) $\forall x\ (F(x) \wedge P(x))$
f) $(\neg \forall x\ F(x)) \vee (\exists x\ \neg P(x))$

P55 35

a) There is no counterexample.
b) x=0.
c) x=2.

P65 9

a) $\forall x\, L(x, \text{Jerry})$

b) $\forall x \exists y\, L(x, y)$

c) $\exists y \forall x\, L(x ,y)$

d) $\neg \exists x \forall y\, L(x, y)$

e) $\exists y\, \neg L(\text{Lydia}, y)$

f) $\exists y \forall x\, \neg L(x, y)$

g) $\exists ! y \forall x\, L(x, y)$

h) $\exists ! x \exists ! y\, (x \neq y) \wedge L(\text{Lynn}, x) \wedge L(\text{Lynn}, y)$

i) $\forall x\, L(x, x)$

j) $\exists x \forall y\, (x = y \leftrightarrow L(x, y))$

P68 37

a) There is someone in this class that takes more or less than two different mathematics classes at this school.

b) Every person has either visited Libya or has not visited a country except Libya.

c) Someone has climbed every mountain in the Himalayas.

d) There is someone who has neither been in a movie with Kevin Bacon nor has been in a movie with someone that has been in a movie with Kevin Bacon.

P79 11

Suppose that p_1, p_2,..., p_n are true.

If q is true, with the given argument form, we can know that r is true.

If q is false, then r must be true.

P79 15

a) Correct. Because of universal instantiation and modus ponens.
b) Incorrect. Because of fallacy of affirming the conclusion.
c) Incorrect. Because of fallacy of denying the hypothesis.
d) Correct. Because of universal instantiation and modus tollens

P80 29

Step	Reason
1.$\exists x \neg P(x)$	Premise

2.¬P(a) Existential instantiation from (1)

3.∀x(P(x)∨Q(x)) Premise

4. P(a)∨Q(a) Universal instantiation from (3)

5. Q(a) Disjunctive syllogism from (4) and (2)

6.∀x(¬Q(x)∨S(x)) Premise

7.¬Q(a)∨S(a) Universal instantiation from (6)

8. S(a) Disjunctive syllogism from (5) and (7)

9.∀x(R(x)→¬S(x)) Premise

10. R(a)→¬S(a) Universal instantiation from (9)

11.¬R(a) Modus tollens from (8) and (10)

12.∃x¬R(x) Existential generalization from (11)

P91 17

a) Assume that n is odd. There exists an integer k such that n=2k+1.Then $n^3+5=2(4k^3+6k^2+3k+3)$, so n^3+5 is even.
   So if n^3+5 is odd, then n is even.

b) Assume that n^3+5 is odd and n is odd. We can know that $n^3 = (n^3+5)-5$ is even, but if n is odd, then n^2 and n^3 are both odd. So the assumption is contradictive.
   So if n^3+5 is odd, then n is even.

P91 25

Assume that $r = a/b$ is a root, where a and b are integers and a/b is in lowest terms, which means a and b can't be even at the same time.

From $r^3+r+1=0$ we can know that $a^3+ab^2+b^3=0$.

If a and b are both odd, then the left side is odd, the equation does not hold.

If a is odd and b is even, then the left side is odd, the equation does not hold.

If a is even and b is odd, then the left side is odd, the equation does not hold.

So the assumption is contradictive.

So there is no such a rational root.