1.3

Exercise 22

(a)

P	Q	$P \to Q$
T	T	T
T	F	F
F	T	T
F	F	T

P	Q	$\neg Q$	$\neg P$	$\neg Q \to \neg P$
T	T	F	F	T
T	F	T	F	F
F	T	F	T	T
F	F	T	T	T

(a) answer:$p \to q$ and$\neg Q \to \neg P$ are logically equivallent
(b)$P \to Q$ only when P is T and Q is F them will get F ,$\neg Q \to \neg P$ is same to when P is T and Q is F them will get F,so them are logically equivallent.

1.4

Exercise 14

(a)
$\exists x(x^3 = -1)$
if x =-1 that meaning x^3 will be get -1 too, so that is truth.

(b)
$\exists x(x^4 < x^2)$
if x=1/2 all any one real number more than 0 and less than 1 will be available for this equation.

(c)
$\forall x((-x)^2 = x^2)$
i try all real number like 5, -5 evern 0 they are same,so this equatio is truth.

(d)
$\forall x(2x > x)$
if x is negitive number, for example x=-5, 2x will get -10, that meaning 2x¡x, so this is False.

1.5

0.1 10

(g,h,j)
(g)
$\exists x\exists y(F(Nancy,x) \wedge F(Nancy,y) \wedge x \neq y \wedge \forall z(F(Nancy,z) \rightarrow (z = x \vee z = y)))$

(h)
$\exists y(\forall x F(x,y) \wedge \forall z(\forall w F(w,z)) \rightarrow z = y)$

(j)
$\exists x\exists y(L(x,y) \wedge \forall z(L(x,z) \rightarrow z = y \vee z = x))$

0.2 28

(a)$\forall x\exists y(x^2 = y)$
for the all real number x^2 cna be find a real number y them are same.that is True

(b)$\forall x\exists(y = x^2)$
if y is negitive x will not exist .that is False

(c)$\exists x\forall y(xy = 0)$
if x=0 that meaning the all xy will get 0.that is True

(d)$\exists x\exists y(x + y \neq y = x)$
we can not find x+y are not equal to y+x. that is False

(e)$\forall x(x \neq 0 \to \exists y(xy = 1))$
y=1/x that will be available, so that is True

(f)$\exists x \forall y(y \neq 0 \to xy = 1)$
the y should depend on x, so that is False.

(g)$\forall x \nexists y(x + y = 1)$
y=1-x that is True.

(h)$\exists x \exists y(x + 2y = 2 \land 2x + 4y = 5)$
that is False.

(i)$\forall x \exists y(x + y = 2 \land 2x - y = 1)$
that is False, we cna not find 2 number available on both side.

(j)$\forall x \forall y \exists z(z = (x + y)/2)$
that is available for two real number so that is True.

0.3 30

(a)$\neg\exists y \exists x P(x, y) \equiv \forall y \forall x \neg P(x, y)$

(b)$\neg\forall x \exists y p(x, y) \equiv \exists x \forall y \neg P(x, y)$

(c)$\neg\exists y(Q(y) \land \forall x \neg R(x, y)) \equiv \forall y(\neg Q(y) \lor \exists x R(x, y))$

(d)$\neg\exists y(\exists x R(x, y) \lor \forall x S(x, y)) \equiv \forall y(\forall x \neg R(x, y) \land \exists x \neg S(x, y))$

(e)$\neg\exists y(\forall x \exists z T(x, y, z) \lor \exists x \forall z U(x, y, z)) \equiv \forall y(\exists x \forall z \neg T(x, y, z) \land \forall x \exists z \neg U(x, y, z))$

0.4 32

(a)$\exists z \forall y \forall x T(x, y, z)$ negation statement is $\forall z \exists y \exists x \neg T(x, y, z)$

(b)$\exists x \exists y P(x, y) \land \forall x \forall y Q(x, y)$ negation statement is $\forall x \forall y \neg P(x, y) \lor \exists x \exists y \neg Q(x, y)$

(c)$\exists x \exists y (Q(x,y) \leftrightarrow Q(y,x))$ negation statement is $\forall x \forall y \neg (Q(x,y) \leftrightarrow Q(y,x))$

(d)$\forall y \exists x \exists z (T(x,y,z) \vee Q(x,y))$ negation statement is $\exists y \forall x \forall z (\neg T(x,y,z) \wedge \neg Q(x,y))$