Chapter 2.2

1) If this loop does not contain a stop or a go to, then it will repeat exactly N times.

5)

p	q	~p	~q	~p ∨ q	~p ∨ q → q
T	T	F	F	T	F
T	F	F	T	F	T
F	T	T	F	T	F
F	F	T	T	T	T

7)

p	q	r	~q	p ∧ ~q	p ∧ ~q → r
T	T	T	F	F	T
T	T	F	F	F	T
T	F	T	T	T	T
T	F	F	T	T	F
F	T	T	F	F	T
F	T	F	F	F	T
F	F	T	T	F	T
F	F	F	T	F	T

a)

p	q	r	~r	p ∧ ~r	q ∨ r	p ∧ ~r ⇔ q ∨ r
T	T	T	F	F	T	F
T	T	F	T	T	T	T
T	F	T	F	F	T	F
T	F	F	T	T	F	F
F	T	T	F	F	T	F
F	T	F	T	F	T	F
F	F	T	F	F	T	F
F	F	F	T	F	F	T

13)(a)

p	q	~p	p → q	~p ∨ q
T	T	F	T	T
T	F	F	F	F
F	T	T	T	T
F	F	T	T	T

∴ From the TT, p → q and ~p ∨ q are logically equivalent

(b)

p	q	$\sim q$	$p \to q$	$\sim(p \to q)$	$p \wedge \sim q$
T	T	F	T	F	F
T	F	T	F	T	T
F	T	F	T	F	F
F	F	T	T	F	F

∴ From the TT $\sim(p \to q)$ and $(p \wedge \sim q)$ are logically equivalent

16) A : You paid full price

B : You didn't bgy it at Crown Books

$A \to B$

$B \vee A$

A	B	$A \to B$	$B \vee A$
T	T	T	T
T	F	F	T
F	T	T	T
F	F	T	F

∴ The given statements are not logically equivalent.

17) A: "If 2 is a factor of n and 3 is a factor of n, then 6 is a factor of n."

B: "2 is not a factor of n or 3 is not a factor of n or 6 is a factor of n.

P: 2 is a factor of n

Q: 3 is a factor of n.

R: 6 is a factor of n.

$\sim P$: 2 is not a factor of n.

$\sim Q$: 3 is not a factor of n.

$A: (P \wedge Q) \rightarrow R$

$B: (\sim P \vee \sim Q) \vee R$

$A = (P \wedge Q) \rightarrow R = \sim [P \wedge Q] \vee R$

$= (\sim P \vee \sim Q) \vee R$

$= B$

Therefore, both statements are equivalent.

P	Q	R	$P \wedge Q$	$\sim P \vee \sim Q$	$(P \wedge Q) \to R$	$(\sim P \vee \sim Q) \vee R$
T	T	T	T	F	T	T
T	T	F	T	F	F	F
T	F	T	F	T	T	T
T	F	F	F	T	T	T
F	T	T	F	T	T	T
F	T	F	F	T	T	T
F	F	T	F	T	T	T
F	F	F	F	T	T	T

Thus $(P \wedge Q) \to R \equiv (\sim P \vee \sim Q) \vee R$

20) (a) $p \to q \Rightarrow (\sim p \vee q)$

$\neg(\neg p \vee q) \equiv \neg(\neg p) \vee \neg q$

$\equiv p \wedge \neg q$

p is a square and p is not a rectangle.

(b) Today is New Year's Eve and tomorrow is not January.

(c) The decimal expansion of r is terminating and r is not rational.

(d) q: n is odd or n is 2

$\neg q$: n is not odd and n is not 2.

n is prime and n is not odd and n is not 2.

(e) q: x is positive or x is 0

$\neg q$: x is not positive and x is not 0.

x is non-negative and x is not positive and x is not 0.

(f) q: Jim and Sue are her uncle and aunt

$\neg q$: Jim is not her uncle or Sue is not her aunt.

Tom is Ann's father and Jim is not her uncle or Sue is not her aunt.

(g) q: n is divisible by 2 and n is divisible by 3

$\neg q$: n is not divisible by 2 or n is not divisible by 3.

n is divisible by 6 and n is not divisible by 2 or n is not divisible by 3.

22) (a) Contrapositive of $p \to q$ is $\neg q \to \neg p$

If p is not a rectangle, then p is not a square.

(b) If tomorrow is not January, then today is not New Year's Eve.

(c) If r is not rational, then the decimal expansion of r is not terminating

(d) If either n is odd or n is not 2, then n is not prime.

(e) If either x is not positive or x is not 0, then x is not non-negative

(f) If either Jim is not Ann's uncle or Sue is not her aunt, then Tom is not her father

(g) If either n is not divisible by 2 or n is not divisible by 3, then n

is not divisible by 6.

23) a) Converse: If p is rectangle, then p is a square.

Inverse: If p is not a square, then p is not a rectangle.

b) Converse: If tomorrow is January, then today is New Year's Eve

Inverse: If today is not New Year's Eve, then tomorrow is not January.

c) Converse: If r is rational, then the decimal expansion of r is terminating.

Inverse: If the decimal expansion of r is not terminating, then r is not rational.

d) Converse: If n is odd or n is 2, then n is prime.

Inverse: If n is not prime, then n is not odd and n is not 2.

e) Converse: If x is positive or x is 0 then x is non-negative

Inverse: If x is non-negative, then x is not positive and x is not 0.

f) Converse: If Jim is Ann's uncle and Sue is her aunt, then Tom is her father.

Inverse: If Tom is not Ann's father, then Jim is not her uncle or Sue is not her aunt.

g) Converse: If n is divisible by 2 and n is divisible by 3, then n is divisible by 6.

Inverse: If n is not divisible by 6, then n is not divisible by 2 or n is not divisible by 3.