Section 1.1

1. **a)** Yes, T **b)** Yes, F **c)** Yes, T **d)** Yes, F **e)** No **f)** No **3.** **a)** Linda is not younger than Sanjay. **b)** Mei does not make more money than Isabella. **c)** Moshe is not taller than Monica. **d)** Abby is not richer than Ricardo.

11. **a)** Sharks have not been spotted near the shore. **b)** Swimming at the New Jersey shore is allowed, and sharks have been spotted near the shore. **c)** Swimming at the New Jersey shore is not allowed, or sharks have been spotted near the shore. **d)** If swimming at the New Jersey shore is allowed, then sharks have not been spotted near the shore. **e)** If sharks have not been spotted near the shore, then swimming at the New Jersey shore is allowed. **f)** If swimming at the New Jersey shore is not allowed, then sharks have not been spotted near the shore. **g)** Swimming at the New Jersey shore is allowed if and only if sharks have not been spotted near the shore. **h)** Swimming at the New Jersey shore is not allowed, and either swimming at the New Jersey shore is allowed or sharks have not been spotted near the shore. (Note that we were able to incorporate the parentheses by using the word "either" in the second half of the sentence.) **13.** **a)** $p \wedge q$ **b)** $p \wedge \neg q$ **c)** $\neg p \wedge \neg q$ **d)** $p \vee q$ **e)** $p \rightarrow q$ **f)** $(p \vee q) \wedge (p \rightarrow \neg q)$ **g)** $q \leftrightarrow p$

25. **a)** If the wind blows from the northeast, then it snows. **b)** If it stays warm for a week, then the apple trees will bloom. **c)** If the Pistons win the championship, then they beat the Lakers. **d)** If you get to the top of Long's Peak, then you must have walked 8 miles. **e)** If you are world famous, then you will get tenure as a professor. **f)** If you drive more than 400 miles, then you will need to buy gasoline. **g)** If your guarantee is good, then you must have bought your CD player less than 90 days ago. **h)** If the water is not too cold, then Jan will go swimming. **i)** If people believe in science, then we will have a future.

29. State the converse, contrapositive, and inverse of each of these conditional statements.

a) If it snows today, I will ski tomorrow.
b) I come to class whenever there is going to be a quiz.
c) A positive integer is a prime only if it has no divisors other than 1 and itself.

Sol Given $p \to q$. We have

converse : $q \to p$

contrapositive : $\neg q \to \neg p$

inverse : $\neg p \to \neg q$

a) p: it snows today , q: I will ski tomorrow

Converse: If I will ski tomorrow , then it snows today

contrapositive: If I will not ski tomorrow , then it doesn't show today

inverse: If it doesn't show today , then I will not ski tomorrow.

b) p: there is going to be a quiz , q: I come to class.

Converse: If I come to class , then there is going to be a quiz

Contrapositive: If I don't come to class , then there is not going to be a quiz

inverse: If there is not going to be a quiz , then I don't come to class

c) p: A postive integer is a prime. q: it has no divisors other than 1 and itself.

Converse: If a postive integer has no divisors other than 1 and itself. then it is a prime

Contrapositive: If a postive integer has ~~no~~ divisors other than 1 and itself., then it is NOT a prime

Inverse: If A postive integer is NOT a prime, then it has ~~no~~ divisors other than 1 and itself.

31. **a)** 2 **b)** 16 **c)** 64 **d)** 16

33. **a)**

p	$\neg p$	$p \wedge \neg p$
T	F	F
F	T	F

b)

p	$\neg p$	$p \vee \neg p$
T	F	T
F	T	T

c)

p	q	$\neg q$	$p \vee \neg q$	$(p \vee \neg q) \rightarrow q$
T	T	F	T	T
T	F	T	T	F
F	T	F	F	T
F	F	T	T	F

d)

p	q	$p \vee q$	$p \wedge q$	$(p \vee q) \rightarrow (p \wedge q)$
T	T	T	T	T
T	F	T	F	F
F	T	T	F	F
F	F	F	F	T

f)

p	q	$p \rightarrow q$	$q \rightarrow p$	$(p \rightarrow q) \rightarrow (q \rightarrow p)$
T	T	T	T	T
T	F	F	T	T
F	T	T	F	F
F	F	T	T	T

e)

p	q	$p \rightarrow q$	$\neg q$	$\neg p$	$\neg q \rightarrow \neg p$	$(p \rightarrow q) \leftrightarrow (\neg q \rightarrow \neg p)$
T	T	T	F	F	T	T
T	F	F	T	F	F	T
F	T	T	F	T	T	T
F	F	T	T	T	T	T

39.

p	q	r	$p \rightarrow (\neg q \vee r)$	$\neg p \rightarrow (q \rightarrow r)$	$(p \rightarrow q) \vee (\neg p \rightarrow r)$	$(p \rightarrow q) \wedge (\neg p \rightarrow r)$	$(p \leftrightarrow q) \vee (\neg q \leftrightarrow r)$	$(\neg p \leftrightarrow \neg q) \leftrightarrow (q \leftrightarrow r)$
T	T	T	T	T	T	T	T	T
T	T	F	F	T	T	T	T	F
T	F	T	T	T	T	F	T	T
T	F	F	T	T	T	F	F	F
F	T	T	T	T	T	T	F	F
F	T	F	T	F	T	F	T	T
F	F	T	T	T	T	T	T	F
F	F	F	T	T	T	F	T	T

48. Evaluate each of these expressions.

a) $1\ 1000 \wedge (0\ 1011 \vee 1\ 1011)$
b) $(0\ 1111 \wedge 1\ 0101) \vee 0\ 1000$
c) $(0\ 1010 \oplus 1\ 1011) \oplus 0\ 1000$
d) $(1\ 1011 \vee 0\ 1010) \wedge (1\ 0001 \vee 1\ 1011)$

Sol:

(a) $0\ 1011 \vee 1\ 1011 = 1\ 1011$ (bitwise OR (∨))

$1\ 1011 \wedge 1\ 1000 = 1\ 1000$ (bitwise AND (∧))

$\Rightarrow 1\ 1000 \wedge (0\ 1011 \vee 1\ 1011) = 1\ 1000$

(b) $0\ 1111 \wedge 1\ 0101 = 0\ 0101$ (bitwise AND (∧))

$0\ 0101 \vee 0\ 1000 = 0\ 1101$ (Bitwise OR (∨))

$(0\ 1111 \wedge 1\ 0101) \vee 0\ 1000 = 0\ 1101$

(c) $0\ 1010 \oplus 1\ 1011 = 1\ 0001$ (Bitwise XOR ⊕)

$1\ 0001 \oplus 0\ 1000 = 1\ 1001$ (Bitwise XOR ⊕)

$(0\ 1010 \oplus 1\ 1011) \oplus 0\ 1000 = 1\ 1001$

(d) $1\ 1011 \vee 0\ 1010 = 1\ 1011$ (Bitwise OR (∨))

$1\ 0001 \vee 1\ 1011 = 1\ 1011$ (Bitwise OR (∨))

$1\ 1011 \wedge 1\ 1011 = 1\ 1011$ (Bitwise AND (∧))

$(1\ 1011 \vee 0\ 1010) \wedge (1\ 0001 \vee 1\ 1011) = 1\ 1011$