Assignment#1 – CECS 228   
  
**1.** Let p, q, and r be the propositions

p : Grizzly bears have been seen in the area.

q : Hiking is safe on the trail.

r : Berries are ripe along the trail.

Write these propositions using p, q, and r and logical connectives (including negations).

a) Berries are ripe along the trail, but grizzly bears have not been seen in the area.

b) Grizzly bears have not been seen in the area and hiking on the trail is safe, but berries are ripe along the trail.

c) If berries are ripe along the trail, hiking is safe if and only if grizzly bears have not been seen in the area.   
d) It is not safe to hike on the trail, but grizzly bears have not been seen in the area and the berries along the trail are ripe.

e) For hiking on the trail to be safe, it is necessary but not sufficient that berries not be ripe along the trail and for grizzly bears not to have been seen in the area.

f ) Hiking is not safe on the trail whenever grizzly bears have been seen in the area and berries are ripe along the trail.

**2.** Write each of these statements in the form “if p, then q” in English. [Hint: Refer to the list of common ways to express conditional statements.]

a) It snows whenever the wind blows from the northeast.

b) The apple trees will bloom if it stays warm for a week.

c) That the Pistons win the championship implies that they beat the Lakers.

d) It is necessary to walk 8 miles to get to the top of Long’s Peak.

e) To get tenure as a professor, it is sufficient to be world-famous.

f ) If you drive more than 400 miles, you will need to buy gasoline.

g) Your guarantee is good only if you bought your CD player less than 90 days ago.

h) Jan will go swimming unless the water is too cold.  
  
**3.** Construct a truth table for

a. ((p → q) → r) → s.  
b. (p ⊕ q) → (p ⊕¬q)  
c. (p → q) ∧ (¬p → r)

4.   
a. Show that p ↔ q and (p → q) ∧ (q → p) are logically equivalent.  
b. Show that (p → q) ∧ (p → r) and p → (q ∧ r) are logically equivalent.  
c. Show that (p → q) → (r → s) and (p → r) → (q → s) are not logically equivalent.  
  
5. Determine the truth value of each of these statements if the domain consists of all integers.

a) ∀n(n + 1 > n)   
b) ∃n(2n = 3n)

c) ∃n(n = −n)   
d) ∀n(3n ≤ 4n)

6. Translate each of these statements into logical expressions using predicates, quantifiers, and logical connectives.

a) Something is not in the correct place.

b) All tools are in the correct place and are in excellent condition.

c) Everything is in the correct place and in excellent condition.

d) Nothing is in the correct place and is in excellent condition.

e) One of your tools is not in the correct place, but it is in excellent condition.  
  
7. Let W(x, y) mean that student x has visited website y, where the domain for x consists of all students in your school and the domain for y consists of all websites. Express each of these statements by a simple English sentence.

a) W(Sarah Smith, www.att.com)

b) ∃xW(x, www.imdb.org)

c) ∃yW(José Orez, y)

d) ∃y(W(Ashok Puri, y) ∧W(CindyYoon, y))

e) ∃y∀z(y ≠ (David Belcher) ∧ (W(David Belcher, z) → W(y,z)))

f ) ∃x∃y∀z((x≠y) ∧ (W(x, z) ↔ W(y, z)))  
  
8. Let S(x) be the predicate “x is a student,” F(x) the predicate “x is a faculty member,” and A(x, y) the predicate “x has asked y a question,” where the domain consists of all people associated with your school. Use quantifiers to express each of these statements.

a) Lois has asked Professor Michaels a question.

b) Every student has asked Professor Gross a question.

c) Every faculty member has either asked Professor Miller a question or been asked a question by Professor Miller.

d) Some student has not asked any faculty member a question.

e) There is a faculty member who has never been asked a question by a student.

f ) Some student has asked every faculty member a question.

g) There is a faculty member who has asked every other faculty member a question.

h) Some student has never been asked a question by a faculty member.  
  
9. Determine the truth value of each of these statements if

the domain of each variable consists of all real numbers.

a) ∀x∃y(x2 = y)   
b) ∀x∃y(x = y2)

c) ∃x∀y(xy = 0)   
d) ∃x∃y(x + y ≠ y + x)

e) ∀x(x ≠ 0 → ∃y(xy = 1))

f ) ∃x∀y(y ≠ 0 → xy = 1)

g) ∀x∃y(x + y = 1)

h) ∃x∃y(x + 2y = 2 ∧ 2x + 4y = 5)

i) ∀x∃y(x + y = 2 ∧ 2x − y = 1)

j) ∀x∀y∃z(z = (x + y)/2)