Solutions Week 1

1. a) p : "my favorite team is the Montreal Canadians"
q : " I really like the Ottawa Senators."

Answer: $p \vee q$

b) p : "It would be my pleasure to help a student"
q : "The student is registered in my class"

Answer: $q \rightarrow p$

c) p : "You study in computer science at the University of Ottawa."
q : "You must take the course MAT1348."

Answer: $\neg p \rightarrow \neg q$

d) p : "I will go for a walk in the woods"
q : It is snowing tonight.

Answer: $p \leftrightarrow q$

e) p : "You like science"
q : "You like politics"

Answer: $p \wedge \neg q$

2. a) $(p \wedge (p \rightarrow q)) \rightarrow q$

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

b) $(p \rightarrow q) \rightarrow (q \rightarrow p)$

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

c) $(p \vee q) \wedge r$

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

d) $q \rightarrow (\neg r \rightarrow p)$

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

e) $(p \vee q) \rightarrow (\neg q \wedge r)$

p	q	r	$\neg q$	$p \vee q$	$\neg q \wedge r$	$(p \vee q) \rightarrow (\not{q} \wedge r)$
T	T	T	F	T	F	F
T	T	F	F	T	F	F
T	F	T	T	T	T	T
T	F	F	T	T	F	F
F	T	T	F	T	F	F
F	T	F	F	T	F	F
F	F	T	T	F	T	T
F	F	F	T	F	F	T

f) $(q \leftrightarrow p) \oplus (r \rightarrow p)$

p	q	r	$q \leftrightarrow p$	$r \rightarrow p$	$(q \leftrightarrow p) \oplus (r \rightarrow p)$
T	T	T	T	T	F
T	T	F	T	T	F
T	F	T	F	T	T
T	F	F	F	T	T
F	T	T	F	F	F
F	T	F	F	T	T
F	F	T	T	F	T
F	F	F	T	T	F

3. a) $(p \wedge (p \to q)) \to q$

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

The last column is true everywhere. Hence, the proposition is a tautology.

b)

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

The last column is not true everywhere. Hence, the proposition is a neither a tautology or a contradiction.

c)

p	q	$\neg p$	$\neg p \wedge q$	$p \wedge (\neg p \wedge q)$
T	T	F	F	F
T	F	F	F	F
F	T	T	T	F
F	F	T	F	F

The last column is false everywhere. Hence, the proposition is a contradiction.