

Homework 1

1. a) $r \wedge \neg q$
- b) $p \wedge q \wedge r$
- c) $p \rightarrow r$
- d) $p \wedge \neg q \wedge r$
- e) $(p \wedge q) \rightarrow r$
- f) $(p \vee q) \leftrightarrow r$

d. a)

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

b)

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

b)

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

3. a)

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

yes

b)

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

yes

HW1 Cont.

3 c)

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

NO

4.

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

Both columns are the same,
so they are logically equivalent

- 5.
- a) $\exists x \exists z P(x, \text{junior}, z)$ true
 - b) $\forall x \exists y P(x, y, \text{cs})$ false
 - c) $\exists x \exists y \exists z P(x, y, z) \wedge (y \neq \text{junior}) \wedge (z \neq \text{math})$ True
 - d) $\forall x (\exists y, P(x, y, \text{cs}) \vee (\exists z, P(x, \text{sophomore}, z)))$ False
 - e) $\exists z \forall y \exists x P(x, y, z)$ false