HW 1 solution
CS 536

1. $\neg(p \rightarrow \neg q \wedge r \vee (\neg p \vee r) \wedge q \wedge s)$

2. No parentheses are needed: $\forall i : 0 \le i \wedge i < m \rightarrow \exists j : m \le j \wedge j < n \rightarrow b[i] = b[j]$

3. $((((p \vee r) \vee (\neg s)) \rightarrow (((\neg q) \wedge r) \rightarrow (\neg p))) \leftrightarrow ((\neg s) \rightarrow t))$

4. $(\exists m : (((0 \le m) \wedge (m < n)) \wedge (\forall j : (((0 \le j) \wedge (j < m)) \rightarrow ((b[0] \le b[j]) \wedge (b[j] \le b[m]))))))$

5.

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

6. $\neg(\exists x : (\forall y : x \le y) \vee \forall z : x \ge z)$

iff $\forall x : \neg((\forall y : x \le y) \vee \forall z : x \ge z))$	DeMorgan's law
iff $\forall x : \neg(\forall y : x \le y) \wedge \neg\forall z : x \ge z$	DeMorgan's law
iff $\forall x : (\exists y : \neg(x \le y)) \wedge \exists z : \neg(x \ge z)$	DeMorgan's law twice
iff $\forall x : (\exists y : x > y) \wedge \exists z : x < z$	Negation of comparison

7. $\neg((\neg\forall x : f(x) \ge 0) \rightarrow (\forall x : f(x) < 0))$

iff $(\neg\forall x : f(x) \ge 0) \wedge \neg(\forall x : f(x) < 0)$	Negation of $\rightarrow$
iff $(\exists x : \neg(f(x) \ge 0)) \wedge \exists x : \neg(f(x) < 0)$	DeMorgan's law twice
iff $(\exists x : f(x) < 0) \wedge \exists x : f(x) \ge 0$	Negation of comparison twice

8. $LtLast(b,n) \equiv 0 \le n < \text{size}(b) \wedge \forall i : 0 \le i < n \rightarrow b[i] < b[n]$

(For questions 9 and 10 there exist different right answers.)

9. $HasMatch(b, n) \equiv 1 \le n \le size(b)+1 \wedge \exists i : \exists j : 0 \le i < n \wedge 0 \le j < n \wedge i \ne j \wedge b[i] = b[j]$

10. $Partitioned(b,m,n,p)$
$\equiv Index(m) \wedge Index(n) \wedge Index(p-1) \wedge \forall i : \forall j : m \le i < n \le j < p \rightarrow b[i] < b[j]$
where $Index(k) \equiv 0 \le k < size(b)$

