4.3

(a) $S' \to S \{print(S.cnt)\}$

$S \to (L) \{S.cnt = L.cnt + 1\}$

$S \to a \{S.cnt = 0\}$

$L \to L_1, S \{L.cnt = S.cnt + L_1.cnt\}$

$L \to S \{L.cnt = S.cnt\}$

(b) $S' \to S \{print(S.cal)\}$

$S \to (L) \{S.cal = L.cal + 1\}$

$S \to a \{S.cal = 0\}$

$L \to L_1, S \{L.cal = max\{L_1.cal, S.cal\}\}$

$L \to S \{L.cal = S.cal\}$

4.9 (b) $S' \to S \{print(S.val)\}$

$S \to L.R \{S.val = L.val + R.val\}$

$S \to L \{S.val = L.val, L.i = 1\}$

$L \to LB \{L.val = L_1.val + B.c, L_1.i = L.i \times 2, B.i = L.i\}$

$L \to B \{B.i = L.i, L.val = B.c\}$

$R \to RB \{R.val = R_1.val + B.c, R_1.i = R.i/2, B.i = R_1.i/2\}$

$R \to B \{B.i = \frac{1}{2}, R.i = \frac{1}{2}, R.val = B.c\}$ $B \to 0 \mid 1 \{B.c = readin() \cdot B.i\}$

4.12 (a) $S' \to \{S.dep = 0\} S$

$S \to \{L.dep = S.dep + 1\} (L)$

$S \to a \{print(S.dep)\}$

$L \to \{L_1.dep = L.dep\} L_1, \{S.dep = L.dep\} S$

$L \to \{S.dep = L.dep\} S$

(b) $S' \to \{S.start = 0\} S$

$S \to \{S.end = S.start + 1\} a \{print(S.end)\}$

$L \to \{L_1.start = L.start\} L_1, \{S.start = L_1.out + 1\} S \{L.end = S.end\}$

$S \to \{L.start = S.start + 1\} (L) \{S.end = L.end + 1\}$

$L \rightarrow \{S.start = L.start\}\ S\ \{L.end = S.end\}.$