

1. Rewrite the following prefix expressions in postfix notations.

Note: **sqrt** is a unary operator.

(a) \* \* a + b c - d e

(b) - \* 2 sqrt - / / b 2 / b 2 \* \* 4 a c a

2. Draw abstract syntax trees for the expressions in #1.

3. Consider the following grammar for a simplified-postfix-expression.

$E ::= E T + \mid E T - \mid T$   
 $T ::= T F * \mid T F / \mid F$   
 $F ::= \text{Num}$   
 $\text{Num} ::= 0 \mid 1 \mid 2 \mid 3 \mid \dots \mid 9$

Rewrite the grammar in EBNF.

- 4 The following EBNF grammar is based on the syntax of statements in Modula-2:

$S ::= \epsilon$   
     $\mid \text{id} := \text{expr}$   
     $\mid \text{if expr then SL } \{ \text{elsif expr then SL} \} [ \text{else SL} ] \text{ end}$   
     $\mid \text{while expr do SL end}$   
 $\text{SL} ::= S \{ ; S \}$

Note that all words with lower characters are regarded as terminals.

- (a) Rewrite the grammar in BNF.  
(b) Draw syntax charts for S and SL.