Grammar and Syntax

Sentences in a CFG

1. For the following grammar, briefly describe the language it defines in a sentence or two. Assume that the start symbol. Hint: If it's not obvious by inspection, try writing down sentences in the language until you see the patterns emerging. If it is obvious by inspection, write down some sentences generated by the grammar to verify that they match your expectations and fit your English description. Please be as precise as possible in describing the language.

   ```
   <S> -> a <S> b | ε
   ```

Prove Ambiguity

2. Prove that the following grammar is ambiguous.

   ```
   <S> -> <A>
   <S> -> <A> + <A> | <A> - <A> | <A> * <A> | a
   ```

Creating a derivation

3. The equation is given below. Create the left and rightmost **derivation (not parse tree)** for the following grammar.

   ```
   <assign> -> <var> = <expr>
   <expr> -> <factor> * <expr> | <factor>
   <factor> -> <div> / <factor> | <div>
   <div> -> <stmt> + <div> | <stmt>
   <stmt> -> (<expr>) | --<var> | ++<var> | <var>
   <var> -> A|B|C|D|E
   ```

   A = --C/(B+++E*D)

CFG for a Given Language

4. Find a context-free grammar for the following language with $n \geq 0$, $m \geq 0$. Test your work to verify it accepts and rejects the appropriate words.

   $L = \{a^n b^m : m \geq n, m - n \text{ is even}\}$

Hint: When $m > n$ and both m and n are even or both m and n are odd, then $m - n$ is even.

Test cases:

PASS	FAIL
abbb	abb
aaabbbb	aaaabbbbbbb
aaaabbbbbbbbb	b