Homework #2

Name _____ Sec ____

Questions:	Answers:
1. If V denotes the set of symbols {a, b, c, 0, 1}, then a) V^0 = b) V^2 = c) $\|V^3\|$ =	
2. Give the language (each possible string) described by the following grammar. S is the start symbol. (Recall that a language is a subset of V*, where V is the alphabet.) S →a | aTb | aTbTc T →x | xy | xyz	a, axb, axyb, axyzb, axbxc, axybxc, axyzbxc, axbxyc, axybxyc, axyzbxyc, axbxyc, axybxyzc, axyzbxyzc
3. Describe the language (in words) generated by each of the following grammars? a) S →0 S 1 | ε b) S →S S | 1 | 0	
4. Given the following grammar, generate four grammatically correct sentences. The start symbol is Sentence. Sentence →SubjectPart VerbPart SubjectPart → Article Noun Article →a | the | an Noun →monkey | banana | tree | gorilla VerbPart →Verb Object Verb →ate | climbed | licked | laughed Object →NounPart NounPart →Article Noun	

5. Give a grammar for the language Time of Day, which accepts strings such as:

12:36 pm 1:59 am 4:00 pm 2:45 am .

In general the language has strings with hour times from 1 to 12, followed by a colon, followed by minute times from 00 to 59, and then either am or pm.

(Use BNF notation and give good mnemonic names for concepts such as <Time of Day>, which is to be the start symbol, and <Single Hour Digit> for digits that are hour digits, i.e., 1 through 9 but not 0.)

Starting Symbol is <Time of Day>

<Time of Day> ::= <F Hour Digit> <L Hour Digit> ":" <F Minute Digit> <L Minute Digit> <Space> <am/pm>
<F Hour Digit> ::= "1" | "2"
<L Hour Digit> ::= "0" | "1" | "2" | "3" | "4" | "5" | "6" | "7" | "8" | "9"
<F Minute Digit> ::= "0" | "1" | "2" | "3" | "4" | "5"
<L Minute Digit> ::= "0" | "1" | "2" | "3" | "4" | "5" | "6" | "7" | "8" | "9"
<am/pm> ::= "am" | "pm"
<Space> ::= " "

6. Letting <S> be the start symbol, convert the following grammar into a 4-tuple as defined below:

```
<S> ::= wc<S>
<S> ::= {<L>}
<S> ::= s;
<L> ::= <L><S>
<L> ::= ε
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A *context-free grammar with epsilon* G is a 4-tuple:

$G = (V_N, V_T, S, \Phi)$, where:
– V_N is a set of non-terminal symbols
– V_T is a set of terminal symbols
– $S \in V_N$ is a start symbol

– Φ is a finite set of relations from V_N to $(V_T \cup V_N)^+ \cup \{\varepsilon\}$.

Consider the terminal symbols to be individual characters—not character sequences. The symbol ε is a meta-symbol denoting the empty sequence; it is not a terminal symbol.

7. Consider the following Grammar:

<S> ::= wc<S>
<S> ::= {<L>}
<S> ::= s;
<L> ::= <L><S>
<L> ::= ε

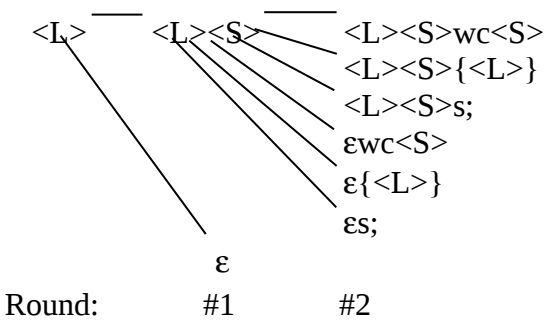
Letting <S> be the start symbol, list all possible strings consisting only of terminals for productions that can be reached by applying:

a) 1 round of productions
b) 2 rounds of productions
c) 3 rounds of productions.

Do the same for <L>, assuming that it is the start symbol.

A "round of productions" applied to a string s of terminal and non-terminal symbols is a set of strings of terminal and non-terminal symbols that can be reached by applying productions to all non-terminals in s. In subsequent rounds, start with all strings of terminals and non-terminals generated in the previous round.

To get you started, suppose we start with <L> and do two rounds.



The answer for 1 round of productions for <L> is ε, and the answer for 2 rounds of productions is s;. All other generated strings have one or more non-terminals in them and are therefore not "strings consisting only of terminals." Note that when we write strings of all terminals in our answer, we drop ε unless it stands alone.