Instructions: The first part of the exam is comprised of 12 multiple choice and 3 true/false questions. Provide your answer to each question (circle only one entry per question) using the scantron sheet that has your name on it**. Be sure to bubble in your exam version (A or B) on the sheet before handing it in.** No phones/calculators/laptops are permitted during the exam. You have 75 minutes to complete both parts of the exam.

1. If a 3-state NFA that recognizes a language A has only 1 accept state, what is the maximum possible number of accept states for an equivalent DFA that recognizes language A.

   A) 1 B) 2 C) 4 D) 6

2. Which of the following regular expressions could generate the string **aabb**?

   A) a(ba)*b B) a(ab)*b C) aba*b* D) ab*(ab)*

3. Which of the following regular expressions could **not** generate the string **abab**?

   A) ab*(ab)* B) a(ba)*b C) (aba)*ab* D) aba*b*

4. Which of the following strings could **not** be generated by the CFG G=({S,A,B},{a,b,(,),+,ε},R,S), where
   R = {$S \to AB;\ \ A \to (A) \mid B \mid a;\ \ B \to A + B \mid b \mid \varepsilon$}

   A) (a+b)(a+b) B) (a+b)b C) b(a+b)+b D) a(a+b)+b

5. How many outgoing edges does each state have in the state diagram of a DFA that recognizes a regular language with 4 alphabet symbols?

   A) 0 B) 1 C) 2 D) 4

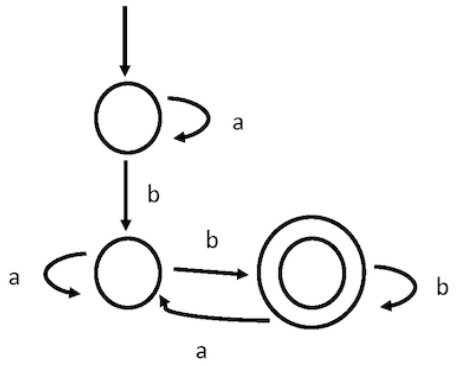
6. A CFG is called _____ if it is possible to produce two distinct parse trees for the same string of nonterminals.

   A) redundant B) ambiguous C) regular
   D) context-free

7. Suppose A and B are both regular languages. Which of the following languages is **not** regular?

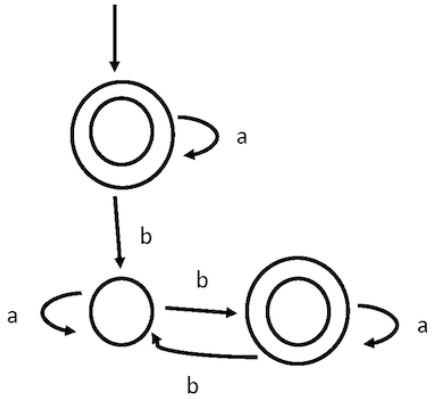
   A) $A \cap B$ B) $A \circ B$ C) $A \cup B$
   D) none, all are regular

8. Which string below **cannot** be accepted by the DFA below?



   A) aaabb B) aabbb C) abba D) abb

9. Which string below can be recognized by the DFA below?



   A) aabbb B) babab C) ε (empty string)
   D) abbab

10. (True/False) The word **abaab** is in the regular language described by the regular expression $(a^+b)^*$.

    A) true B) false

11. (True/False) The minimum pumping length of the regular language defined by the regular expression 10^*10 is 3.

    A) true B) false

12. (True/False) Every context-free language is also a regular language.

    A) true B) false

13. Which of the following languages is **not** context-free?

    A) $a^n b^n a$ B) $b^n a^n b$ C) $b^n a^n$ D) $a^n b^n a^n$

14. Consider the language B={0^m1^n|m>n>0}. Suppose B is a regular language with pumping length *p*. Choose the string s=$0^{p+1}1^p$ from B and partition it into *xyz* so that all three conditions of the Pumping Lemma for regular languages hold. Which of the following conclusions is **not correct**?

    A) If *x* is the empty string, then *y* contains 0's and 1's
    B) If *x* is not the empty string, s'=xy^0z is not in B
    C) If *x* is not the empty string, then y contains only 0's
    D) If *x* is not the empty string, s'=xy^2z is in B

15. Consider the language C={0^n1^m|m>n>0}. Suppose C is a regular language with pumping length *p*. Choose the string s=0^p1^{p+1} from C and partition it into *xyz* so that all three conditions of the Pumping Lemma for regular languages hold. Which of the following conclusions is **not correct**?

    A) If *x* is not the empty string, then *y* contains only 0's
    B) If *x* is not the empty string, s'=xy^0z is not in C
    C) If *x* is not the empty string, s'=xy^0z is in C
    D) If *x* is not the empty string, s'=xy^2z is not in C