10. About Pumping Lemma which of the saying is right?

(A) . Pumping lemma is a necessary condition for regular languages.

(B) . Pumping lemma is a sufficient condition for regular languages.

(C) . Pumping lemma is a necessary and sufficient condition for regular languages.

(D) None of above.

二、问答题（本大题共5小题，每题8分，共40分）

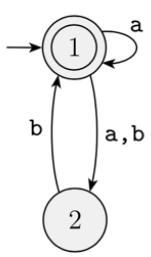
1. Convert the following regular expressions to NFAs.

   (1) a(abb)* ∪b

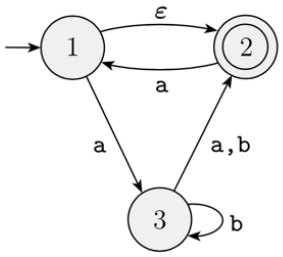
   (2) $a^+ \cup (ab)^+$

   (3) $(a \cup b^+)a^+b^+$

2. Convert the following two nondeterministic finite automata to equivalent deterministic finite automata.



(a)



(b)

3. Convert the following regular expressions to nondeterministic finite automata.

   a. $(0 \cup 1)^*000(0 \cup 1)^*$

   b. $(((00)^*(11)) \cup 01)^*$

   c. $\emptyset^*$

4. Give a context-free grammar that generates the language

   $$A = \{a^i b^j c^k \mid i = j \text{ or } j = k \text{ where } i, j, k \geq 0\}.$$

   Is your grammar ambiguous? Why or why not?

5. Convert the CFG G to an equivalent PDA

   $R \to XRX \mid S$
   $S \to aTb \mid bTa$
   $T \to XTX \mid X \mid \varepsilon$
   $X \to a \mid b$

三、证明题（本大题共6小题，共50分）

1. Show the following languages are not regular: (6 分)

   a. $A_1 = \{0^n 1^n 2^n \mid n \geq 0\}$

   b. $A_2 = \{www \mid w \in \{a, b\}^*\}$

   c. $A_3 = \{a^{2^n} \mid n \geq 0\}$ (Here, a^{2^n} means a string of 2^n a's.)

2. Let A/B = {w| wx ∈ A for some x ∈ B}. Show that if A is regular and B is any language, then A/B is regular. (6 分)

3. (a) Let C be a context-free language and R be a regular language. Prove that the language C ∩ R is context free. (5 分)
   (b) Let A = {w | w ∈{a, b, c}* and w contains equal numbers of a's, b's, and c's}. Use part (a) to show that A is not a CFL. (5 分)

4. Show that the following languages are not context free

   (a) $\{0^n\#0^{2n}\#0^{3n} \mid n \geq 0\}$ (5 分)

   (b) {w#t |w is a substring of t, where w, t ∈ {a,b}* } (5 分)

5. Show that the problem of determining whether a CFG generates all strings in 1* is decidable. In other words, show that {<G> | G is a CFG over {0,1} and 1* ∈ L(G) } is a decidable language. (6 分)

6. A cut in an undirected graph is a separation of the vertices V into two disjoint subsets S and T. The size of a cut is the number of edges that have one endpoint in S and the other in T. Let MAX-CUT = {<G, k> | G has a cut of size k or more}. Show that MAX-CUT is NP-complete. (12 分)