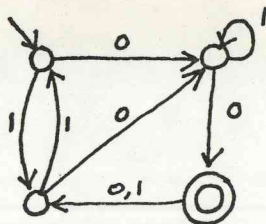
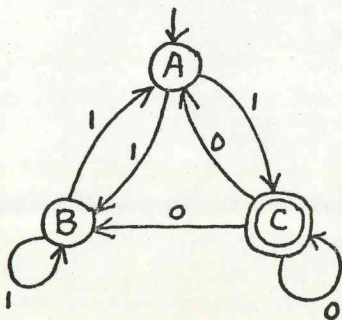


- 1.) Show that the class of context-free languages is closed under union.
- 2.) Let L be the language $\{w \in \{a,b\}^* \mid \text{the length of } w \text{ is divisible by 3 and } w \text{ ends in } aa \text{ or } bb \}$.
 - (a) Give a regular expression for L .
 - (b) Give a deterministic finite state automaton accepting L with as few states as possible. A five state automaton is possible.
- 3.) Let $f(m)$ be a positive monotonically increasing function s.t. for all n there is an m s.t. $f(m+1) > f(m) + n$. Show that $\{a^{f(m)} \mid m \geq 1\}$ is not a regular language. [If you have trouble with this then use $f(m) = 2^m$].
- 4.) Do one of the following:
 - (a) Give a DFA accepting $h^{-1}(L)$ where h is the homomorphism given by $h(a) = 01$ and $h(b) = 10$ and L is the language accepted by the following DFA.



- (b) Give a DFA equivalent to the following NFA.



5.) Do one of the following

(a) Give a CFG generating the (non-regular) language

$$L = \{0^n 1^m 0^{n+m} \mid n, m \geq 0\}.$$

(b) Give a Greibach Normal Form grammar generating the language

$$L = \{x = x^R \mid x \in (0 + 1)^+\}.$$