Question 1

$G = (\{S, A\}, \{a, b\}, R, S)$ where the rules in R are given by

$$S \to aSba \mid A \mid \varepsilon$$
$$A \to aA \mid \varepsilon$$

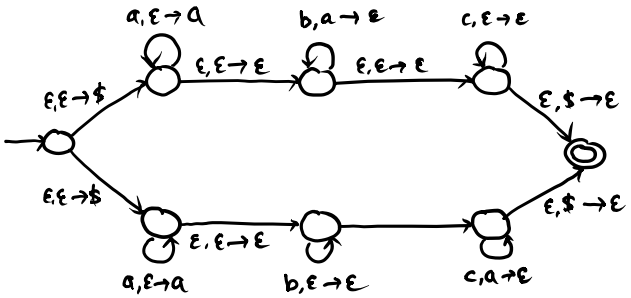
Question 2

a) $S \to S_1 \mid S_2$

$S_1 \to AC$
$A \to aAb \mid \varepsilon$
$C \to cC \mid \varepsilon$

$S_2 \to aS_2c \mid B \mid \varepsilon$
$B \to bB \mid \varepsilon$

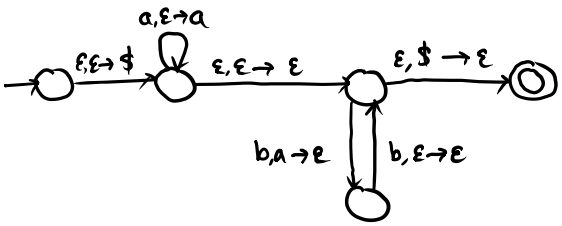
b)



Question 3

a) $S \to AC$
$A \to aAbb \mid \varepsilon$
$C \to cC$

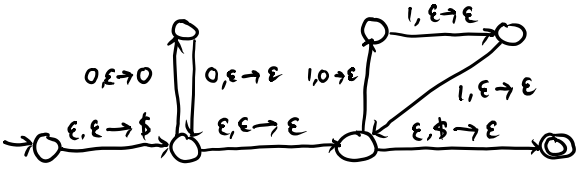
b)



Question 4

a) $S \to 00S111 \mid \varepsilon$

b)



Question 5

1. Add new start variable:
   $S_0 \to S$
   $S \to ASA \mid A \mid \varepsilon$
   $A \to aa \mid \varepsilon$

2. Remove ε-rules
   $S_0 \to S \mid \varepsilon$
   $S \to ASA \mid A \mid AA$
   $A \to aa \mid \varepsilon$

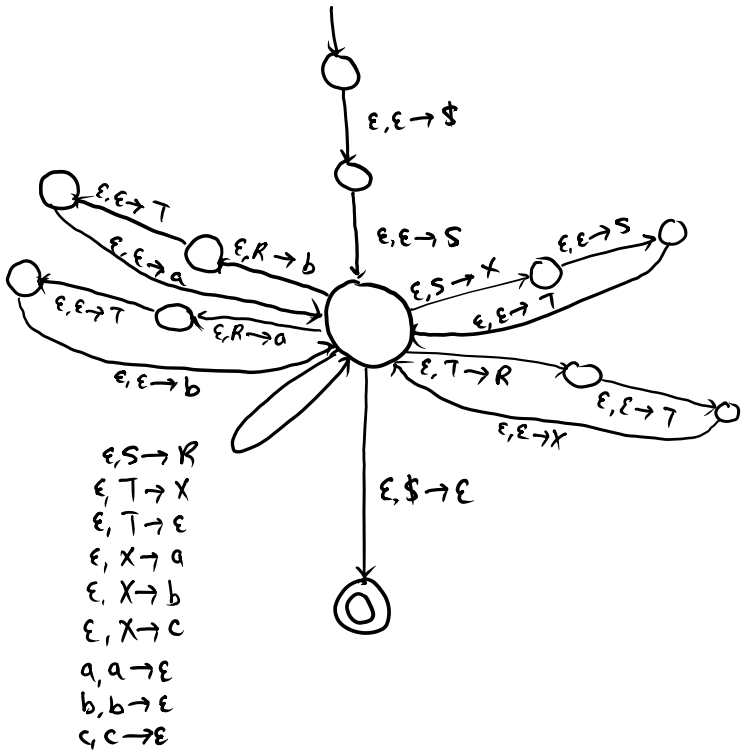
   $S_0 \to S \mid \varepsilon$
   $S \to ASA \mid A \mid AA \mid SA \mid AS$
   $A \to aa$

3. Remove unit rules
   $S_0 \to \varepsilon \mid ASA \mid A \mid AA \mid SA \mid AS$
   $S \to ASA \mid A \mid AA \mid SA \mid AS$
   $A \to aa$

   $S_0 \to \varepsilon \mid ASA \mid AA \mid SA \mid AS \mid aa$
   $S \to ASA \mid AA \mid SA \mid AS \mid aa$
   $A \to aa$

4. Convert remaining rules
   $S_0 \to \varepsilon \mid AU_1 \mid AA \mid SA \mid AS \mid A_1A_1$
   $S \to AU_1 \mid AA \mid SA \mid AS \mid A_1A_1$
   $A \to A_1A_1$
   $U_1 \to SA$
   $A_1 \to a$

Question 6


ε, ε → $
ε, ε → S
ε, ε → T
ε, ε → a
ε, R → b
ε, S → X
ε, ε → S
ε, ε → T
ε, R → a
ε, ε → T
ε, ε → b
ε, T → R
ε, ε → T
ε, ε → X
ε, $ → ε
ε, S → R
ε, T → X
ε, T → ε
ε, X → a
ε, X → b
ε, X → c
a, a → ε
b, b → ε
c, c → ε