Total points: 10
Section 6.1 #9, #11
Section 6.2 #4

Section 6.1

9. (2pts) Eliminate all λ-productions from

S → AaB|aaB,
A → λ,
B → bbA|λ.

Answer

S → aB | aaB | a | aa

B → bb

11. (3pts) Eliminate all unit-productions from the grammar in Exercise 7.

From Exercise 7:

S → a|aA|B|C,

A → aB|λ,

B → Aa,

C → cCD,

D → ddd|Cd.

Answer

S → a|aA|Aa|cCD

A → aB|λ

B → Aa

C → cCD

D → ddd|Cd

Section 6.2

4. (5pts) Convert the following grammar to Chomsky Normal Form:

$S \rightarrow baAB,$
$A \rightarrow bAB \mid \lambda,$
$B \rightarrow BAa \mid A \mid \lambda.$

Answer

Step 1: Remove λ productions.

$S \rightarrow baAB \mid baB \mid baA \mid ba$
$A \rightarrow bAB \mid bB \mid bA \mid b,$
$B \rightarrow BAa \mid A \mid Ba \mid Aa \mid a.$

Step 2: Remove unit/useless productions

$S \rightarrow baAB \mid baB \mid baA \mid ba$
$A \rightarrow bAB \mid bB \mid bA \mid b,$
$B \rightarrow BAa \mid Ba \mid Aa \mid a \mid bAB \mid bB \mid bA \mid b.$

Step 3: Add intermediate variables

$T_a \rightarrow a$
$T_b \rightarrow b$
$V_1 \rightarrow T_bT_a$ (represents ba)
$V_2 \rightarrow AB$
$V_3 \rightarrow BA$
$S \rightarrow V_1V_2 \mid V_1B \mid V_1A \mid T_bT_a$
$A \rightarrow T_bV_2 \mid T_bB \mid T_bA \mid b,$
$B \rightarrow V_3T_a \mid BT_a \mid AT_a \mid a \mid T_bV_2 \mid T_bB \mid T_bA \mid b.$

As long as the final answer is correct, it is OK. Results of first 2 steps are not required.