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3) P: $S \to AC \mid B$, $A \to a$, $C \to c \mid BC$, $E \to aA \mid e$, $F \to bB \mid e$

Phase 1:

$T = \{a, c, e, b\}$

$w_1 = \{A, C, E, F\}$

$w_2 = \{A, C, E, F\}$

$G' = \{(A, C, E, F), (a, c, e, b), S, P\}$

P: $S \to AC$, $A \to a$, $C \to c$, $E \to aA \mid e$, $F \to e$

$Y_1 = \{S\}$ $Y_2 = \{S, A, C\}$

$Y_3 = \{S, A, C, a, c\}$ $Y_4 = \{S, A, C, a, c\}$

$G'' = \{(A, C, S), (a, c), S, P\}$

P: $S \to AC$, $A \to a$, $C \to c$

4) P: S → AB, A → a, B → C|b, C → D, D → E, E → e

B → C, C → D, D → E

① D → E, E → e ⇒ D → e

P: S → AB, A → a, B → C|b, C → D, D → e, E → e

② C → D, D → e ⇒ C → e

P: S → AB, A → a, B → C|b, C → e, D → e, E → e

③ B → C, C → e ⇒ B → e

P: S → AB, A → a, B → e|b, C → e, D → e, E → e

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phase 1

$T = \{a, b, e\}$

$W_1 = \{A, B, C, D, E\}$

$W_2 = \{A, B, C, D, E, S\}$

$W_3 = \{A, B, C, D, E, S\}$

$G' = \{(A, B, C, D, E, S), (a, b, e), S, P\}$

P: S → AB, A → a, B → e|b, C → e, D → e, E → e

phase 2

$Y_1 = \{S\}$ $Y_2 = \{S, A, B\}$

$V_3 = \{ S, A, B, a, e, b \}$

$V_4 = \{ S, A, B, a, e, b \}$

$G'' = \{ (S, A, B), (a, e, b), S, P \}$

$P: S \to AB,\ A \to a,\ B \to e \mid b$

5) $S \to XYXZ,\ X \to aX \mid \varepsilon,\ Y \to bY \mid \varepsilon,\ Z \to c$

$X \to \varepsilon,\ Y \to \varepsilon$

remove $X \to \varepsilon$

$S \to XYXZ \Rightarrow S \to YXZ \mid XYZ \mid YZ$

$X \to aX \Rightarrow X \to a$

$S \to XYXZ \mid YXZ \mid XYZ \mid YZ$

$X \to aX \mid a$

$Y \to bY \mid \varepsilon,\quad Z \to c$

remove $Y \to \varepsilon$

$S \to XYXZ \mid YXZ \mid XYZ \mid YZ$

$\Rightarrow XXZ \mid XZ \mid Z$

$Y \to bY \mid \varepsilon \Rightarrow Y \to b$

$S \to XYXZ \mid YXZ \mid XYZ \mid YZ \mid XXZ \mid XZ \mid Z$

$X \to aX \mid a$

$Y \to bY \mid b$

$Z \to c$

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6)

P: $S \to ASA \mid 1B$, $A \to B \mid S$, $B \to 0 \mid \varepsilon$

$S \to$

P: $S' \to S \mid ASA \mid 1B$, $A \to B \mid S$, $B \to 0 \mid \varepsilon$

remove $B \to \varepsilon$

$S \to 1B \Rightarrow S \to 1$

$A \to B \Rightarrow A \to \varepsilon$

P: $S' \to S$, $S \to ASA \mid 1B \mid 1$, $A \to B \mid S \mid \varepsilon$, $B \to 0$

remove $A \to \varepsilon$

$S \to ASA \Rightarrow S \to AS \mid SA \mid S$

P: $S' \to S$, $S \to ASA \mid 1B \mid 1 \mid AS \mid SA \mid S$, $A \to B \mid S$, $B \to 0$

remove $S' \to S$, $S \to S$, $A \to B$, $A \to S$

$S \to ASA \mid 1B \mid 1 \mid AS \mid SA$

$S' \to S$, $A \to B \mid S$, $B \to 0$

$S' \to ASA \mid 1B \mid 1 \mid AS \mid SA$

$A \to B,\ B \to 0 \Rightarrow A \to 0$

$A \to 0 \mid S \Rightarrow A \to 0 \mid ASA \mid 1B \mid 1 \mid AS \mid SA$

$S' \to ASA,\ S \to ASA,\ A \to ASA$

$X \to SA$

$S' \to AX \mid 1B \mid 1 \mid AS \mid SA$

$S \to AX \mid 1B \mid 1 \mid AS \mid SA$

$A \to AX \mid 1B \mid 1 \mid AS \mid SA$

$B \to 0$

$S' \to 1B$

$S \to 1B$

$A \to 1B$

$Y \to 1$

$X \to SA$

CNF

$S' \to AX \mid YB \mid 1 \mid AS \mid SA$

$S \to AX \mid YB \mid 1 \mid AS \mid SA$

$A \to AX \mid YB \mid 1 \mid AS \mid SA$

$B \to 0$

2) a)

P: $S \rightarrow M1M1M1M$
$M \rightarrow 0M|1M|\varepsilon$

$G = \{(S, M), (0, 1), S, P\}$

d)

P: $S \rightarrow 0S0|1S1|1S0|0S1|0$

$G = \{(S), (0,1), S, P\}$

c) P: $S \rightarrow 0M|1M$
$M \rightarrow 00M|11M|10M|01M|\varepsilon$

$G = \{(S, M), (0, 1), S, P\}$

b) P: $S \rightarrow 0M0|1M1|\varepsilon$
$M \rightarrow 0M|1M|\varepsilon$

$G = \{(S, M), (0, 1), S, P\}$