



$$① \quad L = \{ a^{n+1} b^n c^{n-1} : n \geq 1 \}$$

$$S \rightarrow aab \mid aaXbc$$

$$aX \rightarrow aabY \mid aab$$

$$Yb \rightarrow bY$$

$$Yc \rightarrow Xcc$$

$$bX \rightarrow Xb$$

$$aaXbc$$

$$aaabYbc$$

$$aaabbc$$

$$aaabXcc$$

$$② \quad L = \{ a^n b^n a^{2n} : n \geq 1 \}$$

$$S \rightarrow abaa \mid abYa$$

$$aX \rightarrow aabY \mid aab$$

$$bX \rightarrow Yb$$

$$Ya \rightarrow Xaaa$$

$$Yb \rightarrow bY$$

$$abYa$$

$$abXaaaa$$

$$aXbaaaa$$

$$aaabYbaaaa$$

$$③ \quad S \rightarrow aIXaD \mid bIXbD$$

$$IX \rightarrow bIB \mid aIA/N$$

$$Aa \rightarrow aA$$

$$Ab \rightarrow bA$$

$$Ba \rightarrow aB$$

$$Bb \rightarrow bB$$

$$abIBaD$$

$$aX \rightarrow Xa$$

$$bX \rightarrow Xb$$

$$Na \rightarrow aN$$

$$Nb \rightarrow bN$$

$$AD \rightarrow XaD$$

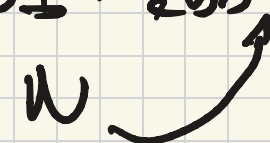
$$BD \rightarrow XbD$$

$$ND \rightarrow \lambda$$

$$abIa bXD$$

$$c b b I X a b b D$$

w



4

$$S \rightarrow ABCS \mid ABC$$

$$Z \rightarrow CS \mid C$$

$$AB \rightarrow BA$$

$$AC \rightarrow CA$$

$$BA \rightarrow AB$$

$$BC \rightarrow CB$$

$$CB \rightarrow BC$$

$$CA \rightarrow AC$$

$$A \rightarrow a$$

$$B \rightarrow b$$

$$C \rightarrow cC \mid c$$