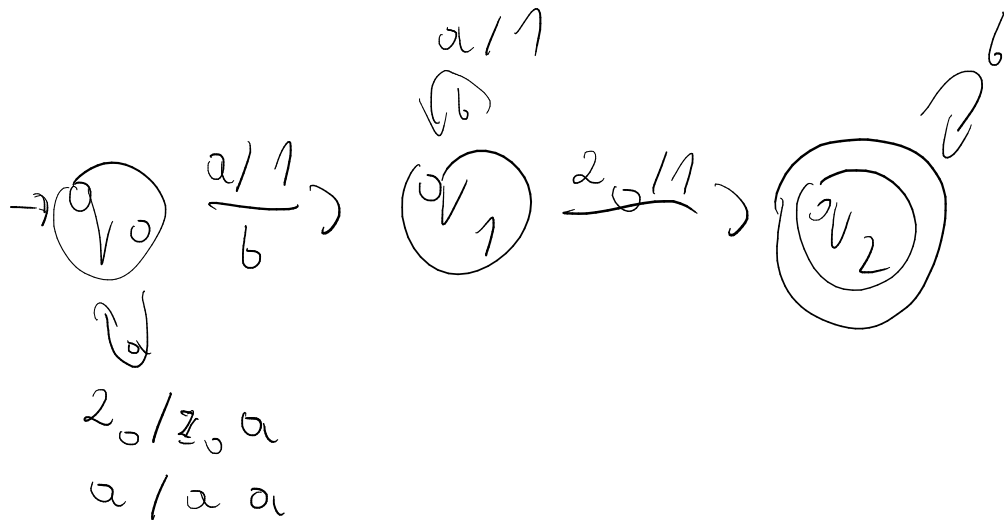


⑤ D

$$L_1 = \{a^n b^m : 1 \leq n \leq m\}$$



⑦

$$a) L_1 = \{a^n b^m c^{n+m} : n, m \geq 0\}$$

$$S \rightarrow aSc \mid A$$

$$A \rightarrow bAc \mid bc$$

$$S \rightarrow aSc \rightarrow aaSc \rightarrow aaA cc \rightarrow$$

$$\rightarrow aabAccc \rightarrow aabbbccccc \quad \checkmark$$

$$b) L_2 = \{a^n b^m : 0 \leq n \leq m\}$$

$$S \rightarrow aAbb$$

$$A \rightarrow aAb \mid \epsilon$$

$$B \rightarrow Bb \mid \epsilon$$

$$S \rightarrow aABbb \rightarrow aAbBbb \rightarrow abBbb \rightarrow abbb \quad \checkmark$$

$$c) L_3 = \{ a^n b^k c^n : n \geq 0, k \geq 5 \}$$

$$S \rightarrow A \mid B$$

$$A \rightarrow aAc \mid \epsilon$$

$$B \rightarrow bbb \mid \epsilon$$

$$C \rightarrow cccccc$$

$$\begin{aligned} S &\rightarrow aAc \rightarrow aaccc \rightarrow aabccc \rightarrow \\ &\rightarrow aabcccccc \end{aligned}$$

$$d) L_4 = \{ a^n b^{2n}, n \geq 0 \}$$

$$S \rightarrow aAb$$

$$A \rightarrow aAb \mid \epsilon$$

$$S \rightarrow aAb \rightarrow aaAbbb \rightarrow aaaa bbbbbb$$