

$$a) \varepsilon = [a, b]$$

$$Q = [1, 2, 3, 4, 5, 6]$$

$$q_0 = 1$$

$$F = 6$$

$$V = \overset{1}{A}, \overset{2}{B}, \overset{3}{C}, \overset{4}{D}, \overset{5}{E}, \overset{6}{F}$$

$$A \rightarrow bB$$

$$B \rightarrow aC$$

$$B \rightarrow bB$$

$$C \rightarrow aC$$

$$C \rightarrow bD$$

$$D \rightarrow aE$$

$$D \rightarrow bB$$

$$E \rightarrow aE$$

$$E \rightarrow bF$$

$$F \rightarrow aE$$

$$F \rightarrow bF$$

$$S \rightarrow A$$

$$F \rightarrow ?$$

$$\gamma^1: |1, b| = 2$$

$$\gamma^2: |2, a| = 3$$

$$\gamma^3: |2, b| = 2$$

$$\gamma^4: |3, a| = 3$$

$$\gamma^5: |3, b| = 4$$

$$\gamma^6: |4, a| = 5$$

$$\gamma^7: |4, b| = 2$$

$$\gamma^8: |5, a| = 5$$

$$\gamma^9: |5, b| = 6$$

$$\gamma^{10}: |6, a| = 5$$

$$\gamma^{11}: |6, b| = 6$$

$$\gamma^{12}: |6, b| = 6$$

$$\gamma^{13}: |6, b| = 6$$

$$\gamma^{14}: |6, b| = 6$$

$$\gamma^{15}: |6, b| = 6$$

$$\gamma^{16}: |6, b| = 6$$

$$\gamma^{17}: |6, b| = 6$$

$$\gamma^{18}: |6, b| = 6$$

$$\gamma^{19}: |6, b| = 6$$

$$\gamma^{20}: |6, b| = 6$$

$$\gamma^{21}: |6, b| = 6$$

$$\gamma^{22}: |6, b| = 6$$

$$\gamma^{23}: |6, b| = 6$$

$$\gamma^{24}: |6, b| = 6$$

$$\gamma^{25}: |6, b| = 6$$

$$\gamma^{26}: |6, b| = 6$$

$$\gamma^{27}: |6, b| = 6$$

$$\gamma^{28}: |6, b| = 6$$



B)  $\Sigma = \{a, b, c\}$

$Q = \{1, 2, 3, 4, 5, 6, 7\}$

$q_0 = 1$

$F = 7$

$V = \{A, B, C, D, E, F, G\}$

$A \rightarrow aB$

$A \rightarrow bA$

$A \rightarrow cA$

$B \rightarrow aC$

$B \rightarrow bA$

$B \rightarrow cA$

$C \rightarrow cC$

$C \rightarrow bD$

$C \rightarrow cC$

$D \rightarrow aC$

$D \rightarrow bE$

$D \rightarrow cC$

$E \rightarrow aE$

$E \rightarrow bE$

$E \rightarrow cF$

$F \rightarrow aE$

$F \rightarrow cG$

$G \rightarrow aG$

$G \rightarrow bG$

$G \rightarrow cG$

$G \rightarrow ?$

$S \rightarrow A$

$\delta: 1, a, 1 = 2$

$\delta: 1, b, 1 = 1$

$\delta: 1, c, 1 = 1$

$\delta: 2, a, 1 = 3$

$\delta: 3, a, 1 = 3$

$\delta: 3, b, 1 = 4$

$\delta: 3, c, 1 = 3$

$\delta: 4, a, 1 = 3$

$\delta: 4, b, 1 = 5$

$\delta: 4, c, 1 = 3$

$\delta: 5, a, 1 = 5$

$\delta: 5, b, 1 = 5$

$\delta: 5, c, 1 = 6$

$\delta: 6, a, 1 = 5$

$\delta: 6, c, 1 = 7$

$\delta: 7, a, 1 = 7$

$\delta: 7, b, 1 = 7$

$\delta: 7, c, 1 = 7$

$S \rightarrow A$

$A \rightarrow ab \mid bA \mid cA$

$B \rightarrow aC \mid bA \mid cA$

$C \rightarrow aC \mid bD \mid cC$

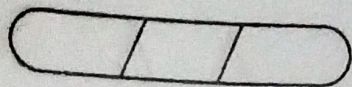
$D \rightarrow aC \mid bE \mid cC$

$E \rightarrow aE \mid bE \mid cF$

$F \rightarrow cF \mid aE \mid cG$

$G \rightarrow aG \mid bG \mid cG \mid ?$





c)  $\Sigma = \{0, 1\}$

$Q = \{a, b, c, d\}$

$q_0 = a$

$F = \{d\}$

$V = \{A, B, C, D\}$

$A \rightarrow 0A$

$A \rightarrow 1B$

$B \rightarrow 0B$

$B \rightarrow 1C$

$C \rightarrow 0C$

$C \rightarrow 1D$

$D \rightarrow 0D$

$D \rightarrow ?$

$S \rightarrow A$

$\delta^1(a, 0) = a$

$\delta^1(a, 1) = b$

$\delta^1(b, 0) = b$

$\delta^1(b, 1) = c$

$\delta^1(c, 0) = c$

$\delta^1(c, 1) = d$

$\delta^1(d, 0) = d$

$S \rightarrow A \quad 1B$

$A \rightarrow 0A \quad 1B$

$B \rightarrow 0B \quad 1C$

$C \rightarrow 0C \quad 1D$

$D \rightarrow 0D \quad ?$



d)  $\Sigma \{0, 1\}$

$Q \{a, b, c, d\}$

$q_0 = a$

$F = D$

$V = \{A, B, C, D\}$

$\delta: \{a, 0\} = a$

$\delta: \{a, 1\} = b$

$\delta: \{b, 0\} = b$

$\delta: \{b, 1\} = c$

$\delta: \{c, 0\} = c$

$\delta: \{c, 1\} = d$

$\delta: \{d, 0\} = d$

$\delta: \{d, 1\} = b$

$A \rightarrow 0A$

$A \rightarrow 1B$

$B \rightarrow 0B$

$B \rightarrow 1C$

$C \rightarrow 0C$

$C \rightarrow 1D$

$D \rightarrow 0D$

$D \rightarrow 1B$

$D \rightarrow ?$

$S \rightarrow A$

$S \rightarrow A$

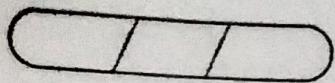
$A \rightarrow 0A \mid 1B$

$B \rightarrow 0B \mid 1C$

$C \rightarrow 0C \mid 1D$

$D \rightarrow 0D \mid 1B \mid ?$





Q1.2)  $\Sigma = \{0, 1\}$

$Q = \{a, b, c, d\}$

$q_0 = a$

$F = d$

$\delta = \{a, 0\} = b$

$\delta = \{a, 1\} = b$

$\delta = \{b, 0\} = c$

$\delta = \{b, 1\} = c$

$\delta = \{c, 0\} = d$

$\delta = \{c, 1\} = d$

$\delta = \{d, 0\} = b$

$\delta = \{d, 1\} = b$

$Q = \{A, B, C, D\}$

$A \rightarrow aB$

$A \rightarrow 0B \mid 1B$

$A \rightarrow bB$

$B \rightarrow 0C \mid 1C$

$B \rightarrow aC$

$C \rightarrow 0D \mid 1D$

$B \rightarrow bC$

$C \rightarrow 0B \mid 1B \mid ?$

$C \rightarrow aD$

$C \rightarrow bD$

$D \rightarrow aB$

$D \rightarrow bB$

$D \rightarrow ?$

$S \rightarrow A$



b)  $\{0, 1\}$   
 $Q \{a, b, c\}$   
 $Q_0: |a|$   
 $F: c$

$\delta: |a, 0| = b$   
 $\delta: |b, 0| = c$   
 $\delta: |b, 1| = D$   
 $\delta: |c, 0| = b$   
 $\delta: |c, 1| = b$

$V \{A, B, C\}$

$A \rightarrow 0B$

$A \rightarrow 0B$

$B \rightarrow 0C$

$B \rightarrow 0C \mid 1C$

$B \rightarrow 1C$

$C \rightarrow 0B \mid 1B \mid ?$

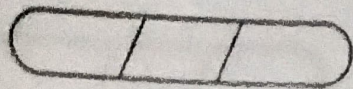
$C \rightarrow 0B$

$C \rightarrow 1B$

$C \rightarrow ?$

$S \rightarrow A$





g)  $\Sigma \{0, 1\}$

$Q \{a, b, c, d\}$

$q_0 = \{a\}$

$F = \{d\}$

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

$\delta = \{a, 0\} = b$

$\delta = \{b, 0\} = c$

$\delta = \{b, 1\} = c$

$\delta = \{c, 0\} = d$

$\delta = \{c, 1\} = d$

$\delta = \{d, 0\} = c$

$\delta = \{d, 1\} = c$

$A \rightarrow 0B$

$B \rightarrow 0C$

$B \rightarrow 1C$

$B \rightarrow ?$

$C \rightarrow 0D$

$C \rightarrow 1D$

$D \rightarrow 0D$

$D \rightarrow 1D$

$D \rightarrow ?$

$S \rightarrow A$

$A \rightarrow 0B$

$B \rightarrow 0C \mid 1C \mid ?$

$C \rightarrow 0D \mid 1D$

$D \rightarrow 0C \mid 1C \mid ?$