3.

(a)

Transition table

state	a	b
→ q_0	q_1	q_0
q_1	q_1	q_2
* q_2	q_0	q_1

(b) i/p: baba

$[q_0, baba]$

$\dashv [q_0, aba]$

$\dashv [q_1, ba]$

$\dashv [q_2, a]$

$\dashv [q_0, \lambda]$

(not accepted)

i/p: baab

$\dashv [q_0, baab]$

$\dashv [q_0, aab]$

$\dashv [q_1, ab]$

$\dashv [q_2, b]$

$\dashv [q_2, \lambda]$ (accepted)

i/p: a bab

$\dashv [q_0, abab]$

$\dashv [q_1, bab]$

$\dashv [q_2, ab]$

$\dashv [q_0, b]$

$\dashv [q_0, \lambda]$

(not accepted)

i/p: abaaab

$\dashv [q_0, abaaab]$

$\dashv [q_1, baaab]$

$\dashv [q_2, aaab]$

$\dashv [q_0, aab]$

$\dashv [q_1, ab]$

$\dashv [q_1, b]$

$\dashv [q_2, \lambda]$ (accepted)

strings baab, abaaab are accepted by
M

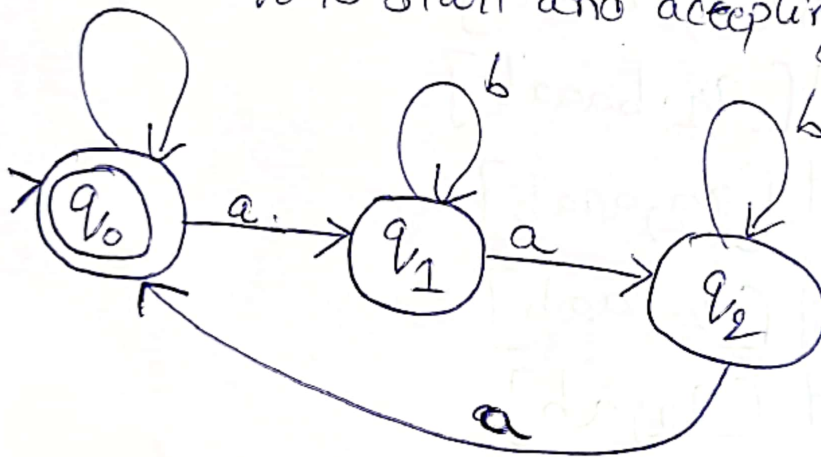(6) the set of strings over $\{a,b\}$ in which the substring aa occurs at least twice
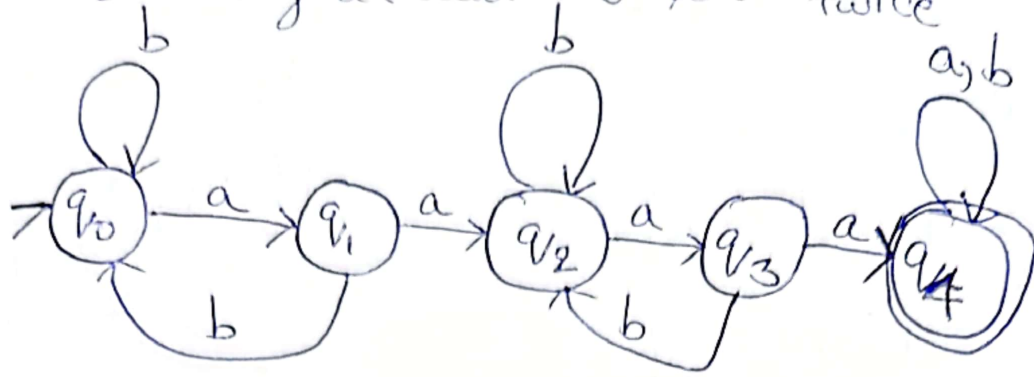
(11) the set of strings over $\{a,b\}$ in which number of a's divisible by three

no of a's possible $= \{ 0, 3, 6, 9, 12, 15, 18 \cdots \}$

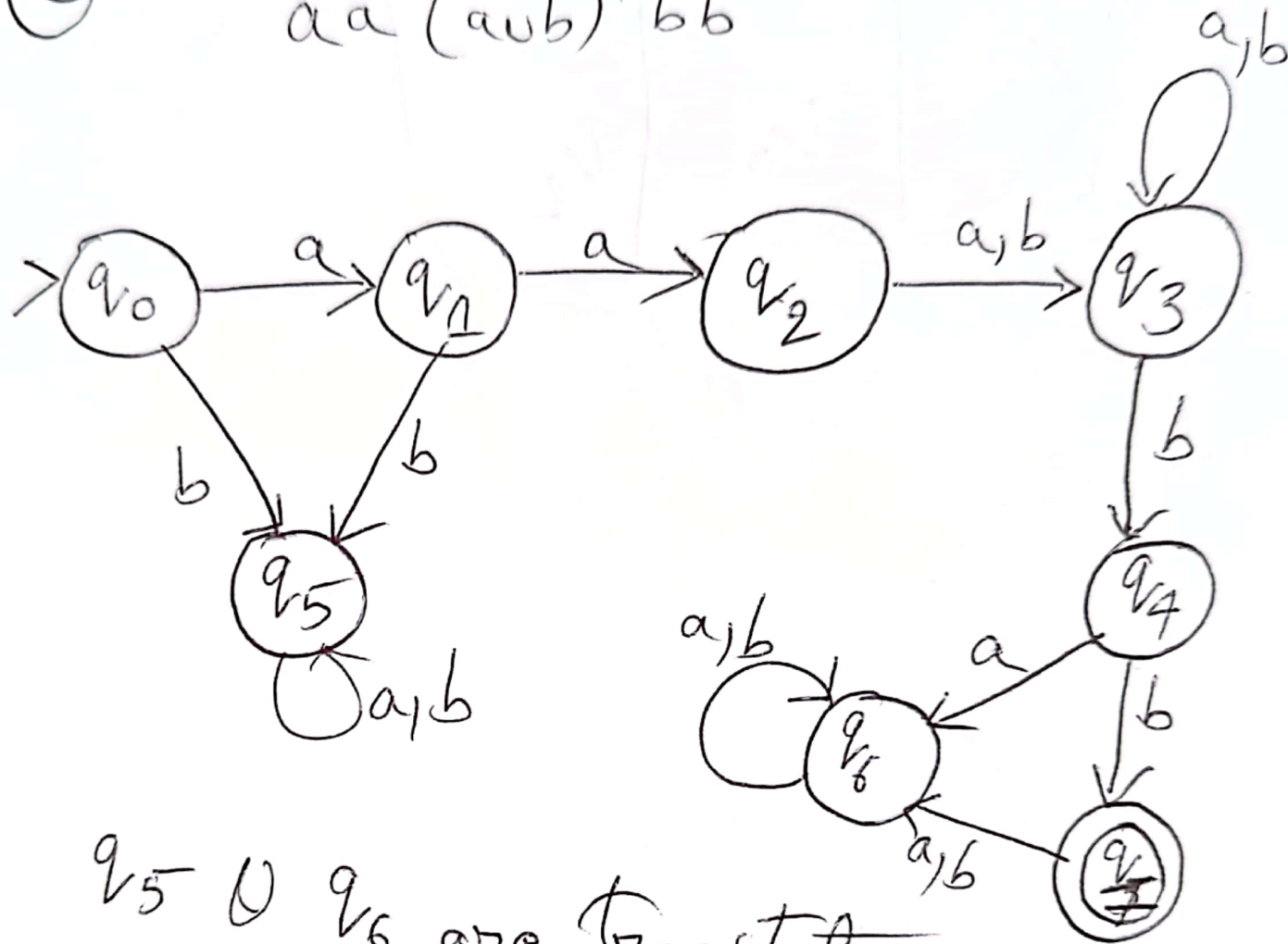as 0 is divisible by 3 so q_0 is start and accepting state

22 Ⓒ

$$aa(a \cup b)^+ bb$$

$q_5 \cup q_6$ are trapstate

$(baubb)^* \cup (ab \cup aa)^*$

p 5

25 (d) $(ba \cup bb)^* \cup (ab \cup aa)^*$

States: q_0 (start, accepting), q_1, q_2

Transitions:
- $q_0 \xrightarrow{b} q_1$
- $q_1 \xrightarrow{a,b} q_0$
- $q_0 \xrightarrow{a} q_2$
- $q_2 \xrightarrow{a,b} q_0$
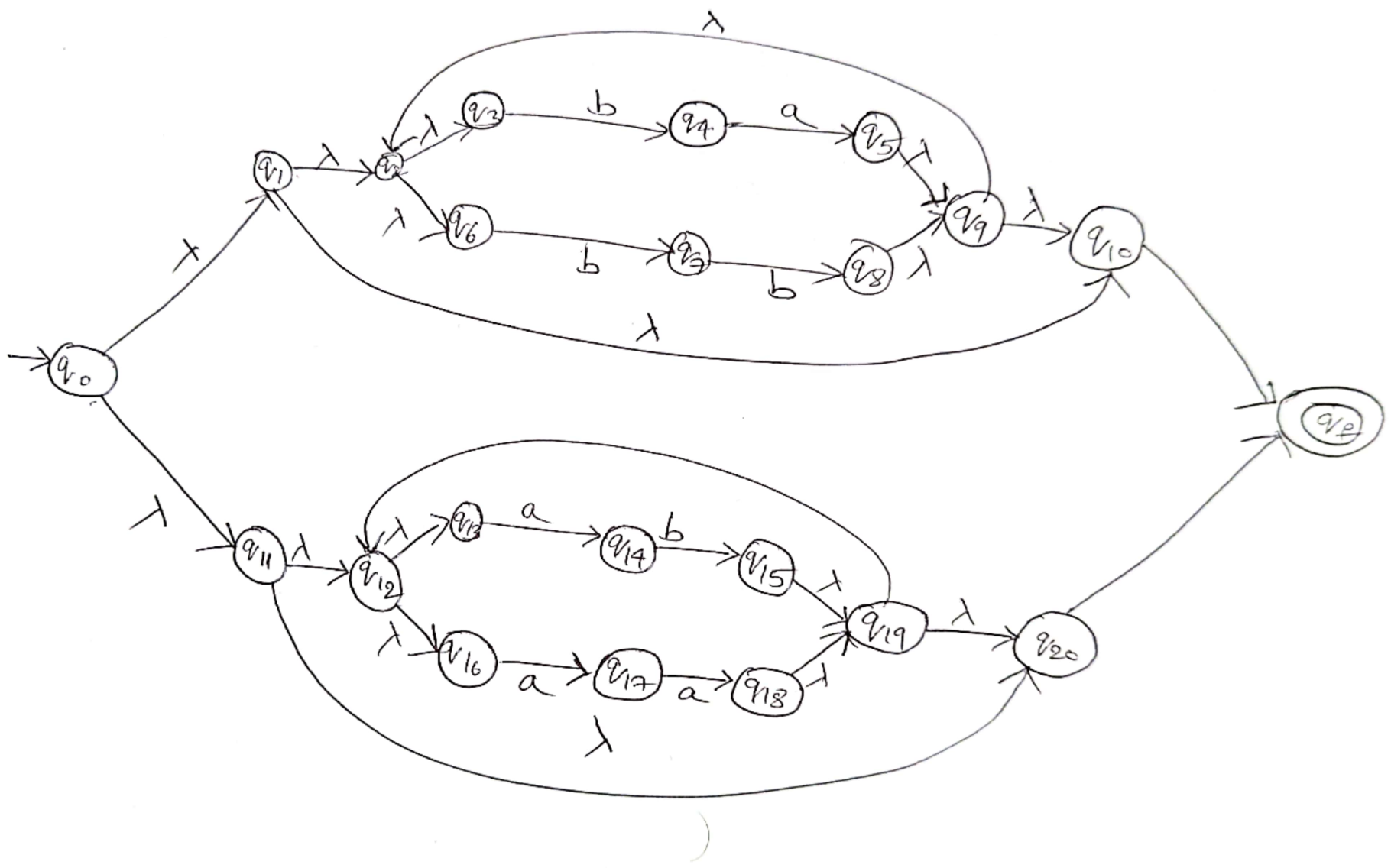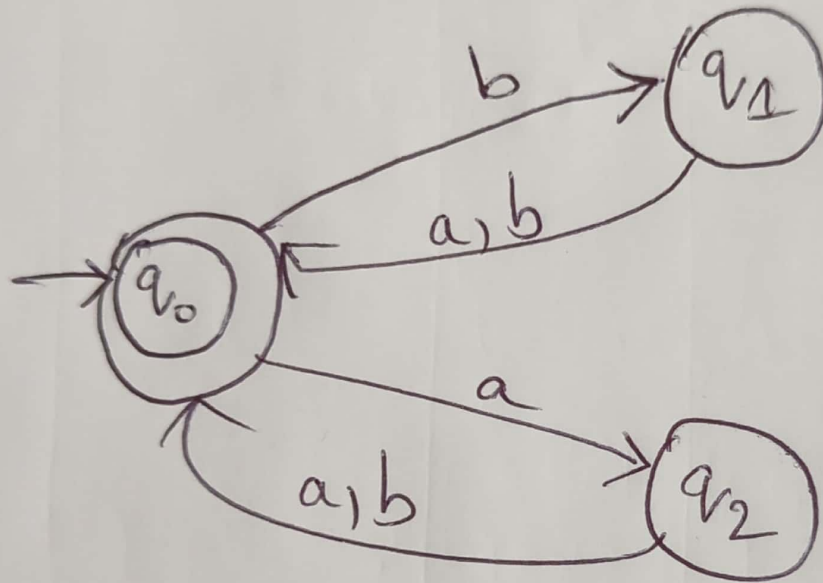
(37) (a) λ-closure $(q_0) = \{q_0, q_1\}$

λ-closure $(q_1) = \{q_1\}$

λ-closure $(q_2) = \{q_2, q_3\}$

λ-closure $(q_3) = \{q_3\}$

$$t(q_0, a) = \bigcup_{\substack{q_j \in \{q_0, q_1\} (\lambda\text{-closure}(q_0))}} \lambda\text{-closure}(\delta(q_j, a))$$

$$= \lambda\text{-closure}(\delta(q_0, a)) \cup \lambda\text{-closure}(\delta(q_1, a))$$

$$= \lambda\text{-closure}(q_1) \cup \phi$$

$$= q_1 \cup \phi$$

$$= q_1$$

$$t(q_0, b) = \lambda(\delta(q_0, b)) \cup \lambda(\delta(q_1, b))$$

$$= \lambda\{q_2\} \cup \lambda(q_1) \cup \lambda(q_3)$$

$$= \{q_2, q_3\} \cup \{q_1\} \cup \{q_3\}$$

$$= \{q_1, q_2, q_3\}$$

$$t(q_1, a) = \bigcup_{q_j \in \{q_1\}} \lambda\text{-closure}(\delta(q_j, a))$$

$$= \lambda(\delta(q_1, a))$$

$$= \lambda(\emptyset) = \emptyset$$

$$t(q_1, b) = \lambda(\delta(q_1, b)) = \lambda(q_1, q_3)$$

$$= \{q_1, q_3\}$$

$$t(q_2, a) = \lambda(\delta(q_2, a)) \cup \lambda(\delta(q_3, a))$$

$$= \lambda(\emptyset) \cup \lambda\{q_3, q_0\}$$

$$= \emptyset \cup \{q_0, q_3\} \cup \{q_1\} = \{q_0, q_1, q_3\}$$

$$t(q_2, b) = \lambda(\delta(q_2, b)) \cup \lambda(\delta(q_3, b))$$

$$= \lambda(\emptyset) \cup \lambda(q_2) = \{q_2, q_3\}$$

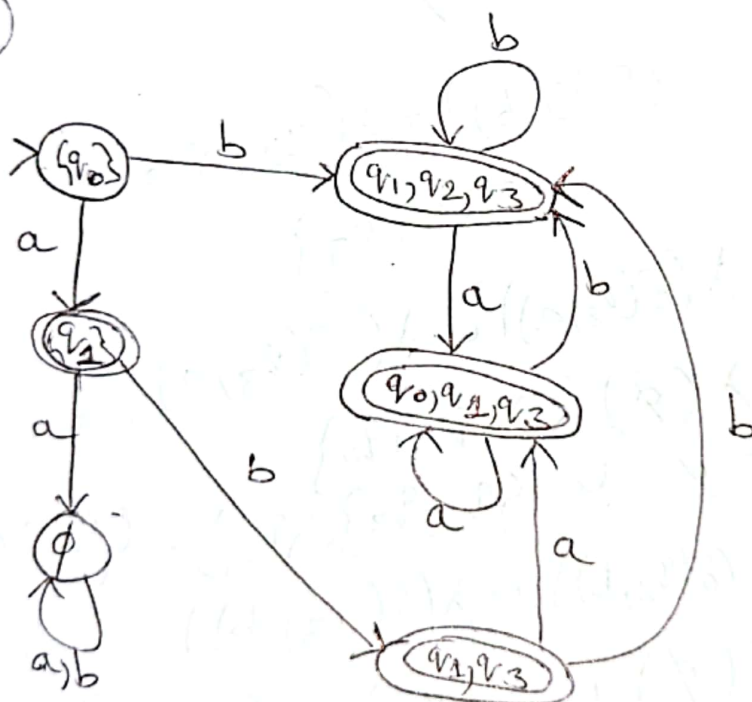$$t(q_3, a) = \lambda(\delta(q_3, a)) = \lambda(q_3, q_0)$$

$$= \{q_1, q_0, q_3\}$$

$$t(q_3, b) = \lambda(\delta(q_3, b))$$
$$= \lambda(q_2)$$
$$= \lambda(q_2) = \{q_2, q_3\}$$

(b)

t	a	b
q_0	q_1	$\{q_1, q_2, q_3\}$ -
q_1	ϕ	$\{q_1, q_3\}$ -
q_2	$\{q_0, q_1, q_3\}$	$\{q_2, q_3\}$
q_3	$\{q_0, q_1, q_3\}$	$\{q_2, q_3\}$

(c)

State(t)	a	b
→ q_0	q_2	$\{q_0, q_1\}$
q_1	q_2	$\{q_1\}$
⇒ q_2	q_1	q_0

DFA
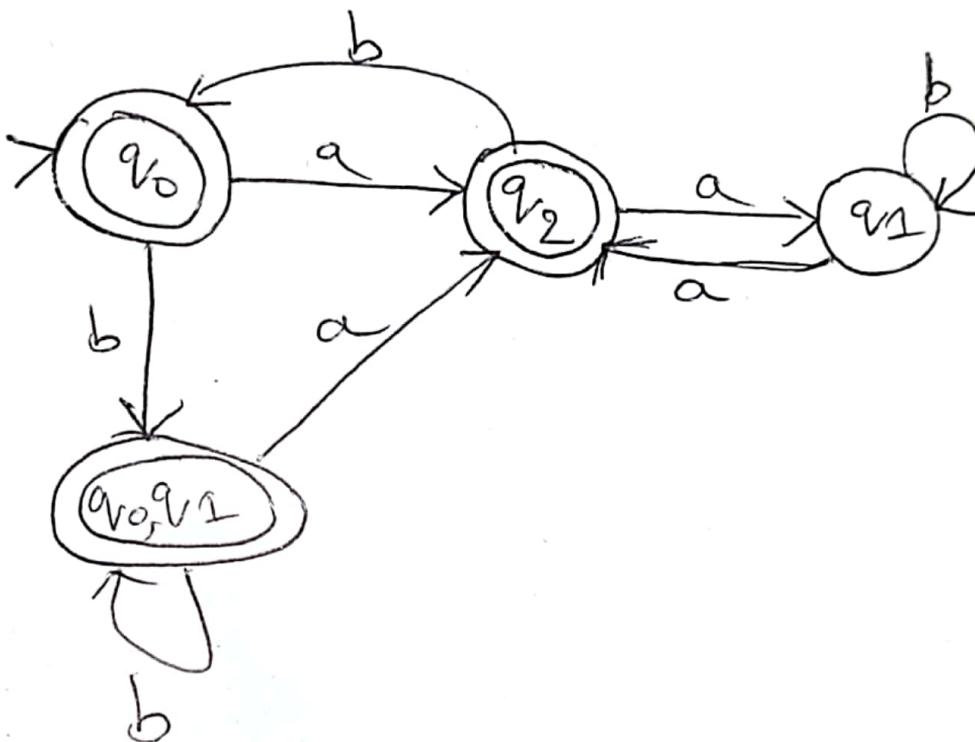
(45) iii (b)

state	a	b
q_0	q_1	q_3
q_1	q_2	q_3
q_2	q_5	q_2
q_3	q_4	q_1
q_4	q_5	q_4
q_5	q_5	q_5

q_0

q_1 | $\times$ |

q_2 | $\times$ | $\checkmark$ |

q_3 | $\times$ | $\checkmark$ | $\times$ |

q_4 | $\times$ | $\checkmark$ | $\times$ | $\checkmark$ |

q_5 | $\times$ | $\checkmark$ | $\times$ | $\checkmark$ | $\times$ |

q_0 q_1 q_2 q_3 q_4 q_5

$\delta(q_2, q_1)$

$$\left.\begin{array}{l} \delta(q_2, a) = q_5 \\ \delta(q_1, a) = q_2 \end{array}\right\} \text{marked as } \times \text{ so}$$

$$\left.\begin{array}{l} \delta(q_2, b) = q_2 \\ \delta(q_1, b) = q_3 \end{array}\right\} \text{marked as } \times \text{ so}$$

(q_3, q_1)

$$\left.\begin{array}{l} \delta(q_3, a) = q_4 \\ \delta(q_1, a) = q_2 \end{array}\right\} \text{marked as } \times \text{ so}$$

$$\left.\begin{array}{l} \delta(q_3, b) = q_1 \\ \delta(q_1, b) = q_3 \end{array}\right\} \text{marked as } \times \text{ so}$$

(q_4, q_1) $\delta(q_4, a) = q_5$ $\Big\}$ marked as $\times$ $\delta(q_4, b) = q_4$

$\delta(q_1, a) = q_2$ $\delta(q_1, b) = q_3$ $\Big\}$

not mar

(q_5, q_1) - $\delta(q_5, a) = q_5$

$\delta(q_1, a) = q_2$ $\Big\}$ marked $\delta(q_5, b) = q_5$

$\delta(q_1, b) = q_3$ $\Big\}$

$\star$ nothing to minimize

not marked