1. (a) M1: $\{q_0\}$ M2: $\{q_0\}$

   (b) M1: $\{q_1\}$ M2: $\{q_0, q_3\}$

   (c) M1: $[q_0, aabb] \vdash [q_1, abb]$
   $\vdash [q_2, bb]$
   $\vdash [q_0, b]$
   $\vdash [q_0, \lambda]$

   Sequence of states: $q_0 \to q_1 \to q_2 \to q_0 \to q_0$

   M2: $[q_0, aabb] \vdash [q_0, abb]$
   $\vdash [q_0, bb]$
   $\vdash [q_1, b]$
   $\vdash [q_3, \lambda]$

   Sequence of states: $q_0 \to q_0 \to q_0 \to q_1 \to q_3$

   (d) M1 does not accept the string $aabb$ but M2 does.

   (e) M1 does not accept ε but M2 does.

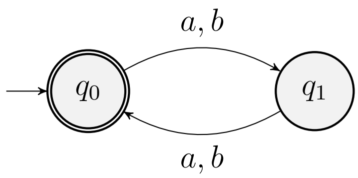
   (f) M1 $= (\{q_0, q_1, q_2\}, \{a, b\}, \delta, q_0, q_1)$ where δ is described as:

	a	b
q_0	q_1	q_0
q_1	q_2	q_2
q_2	q_1	q_0

   M2 $= (\{q_0, q_1, q_2, q_3\}), \{a, b\}, \delta, q_0, \{q_0, q_3\})$ where δ is described as:

	a	b
q_0	q_0	q_1
q_1	q_2	q_3
q_2	q_1	q_0
q_3	q_2	q_3

2. (a)



   (b) ***abbb***: $[q_0, abbb] \vdash [q_1, bbb]$
   $\vdash [q_0, bb]$
   $\vdash [q_1, b]$
   $\vdash [q_0, \lambda]$

   All alphabets are traced and the machine stops at q_0, which is an accepting state. Thus, this machine accepts the string $abbb$.

$\boldsymbol{bbb}$: $[q_0, bbb] \vdash [q_1, bb]$
$\vdash [q_0, b]$
$\vdash [q_1, \lambda]$

All alphabets are traced and the machine stops at q_1, which is not an accepting state. Thus, this machine rejects the string bbb.

$\boldsymbol{baa}$: $[q_0, baa] \vdash [q_1, aa]$
$\vdash [q_0, a]$
$\vdash [q_1, \lambda]$

All alphabets are traced and the machine stops at q_1, which is not an accepting state. Thus, this machine rejects the string baa.

$\boldsymbol{baab}$: $[q_0, baab] \vdash [q_1, aab]$
$\vdash [q_0, ab]$
$\vdash [q_1, b]$
$\vdash [q_0, \lambda]$

All alphabets are traced and the machine stops at q_0, which is an accepting state. Thus, this machine accepts the string $baab$.

(c) The strings $abbb$ and $baab$ are accepted by the machine M.

(d) $((a+b)(a+b))^*$

1. (a)

	a	b
q_0	q_1	q_0
q_1	q_2	q_0
q_2	q_3	q_0
q_3	q_3	q_3

M is a deterministic FA.

(b) $\boldsymbol{aaa}$:
$$\begin{aligned}[q_0, aaa] &\vdash [q_1, aa]\\ &\vdash [q_2, a]\\ &\vdash [q_3, \lambda]\end{aligned}$$

All alphabets are traced and the machine stops at q_3, which is an accepting state. Thus, this machine accepts the string aaa.

$\boldsymbol{aab}$:
$$\begin{aligned}[q_0, aab] &\vdash [q_1, ab]\\ &\vdash [q_2, b]\\ &\vdash [q_0, \lambda]\end{aligned}$$

All alphabets are traced and the machine stops at q_0, which is not an accepting state. Thus, this machine rejects the string aab.

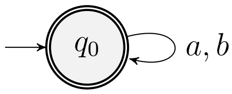
$\boldsymbol{baaab}$:
$$\begin{aligned}[q_0, baaab] &\vdash [q_0, aaab]\\ &\vdash [q_1, aab]\\ &\vdash [q_2, ab]\\ &\vdash [q_3, b]\\ &\vdash [q_3, \lambda]\end{aligned}$$

All alphabets are traced and the machine stops at q_3, which is an accepting state. Thus, this machine rejects the string $baaab$.

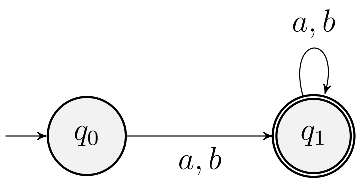
(c) The strings aaa and $baaab$ are accepted by M.

(d) $(a+b)^*aaa(a+b)^*$

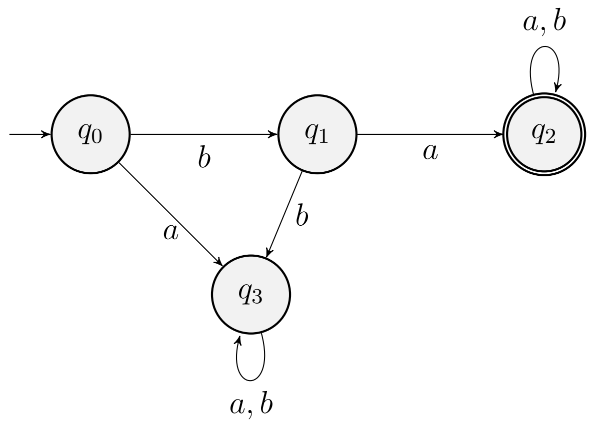
2. (a) $L_1 = (a+b)^*$



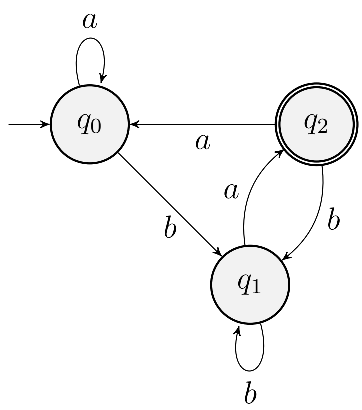
(b) $L_2 = (a+b)(a+b)^*$



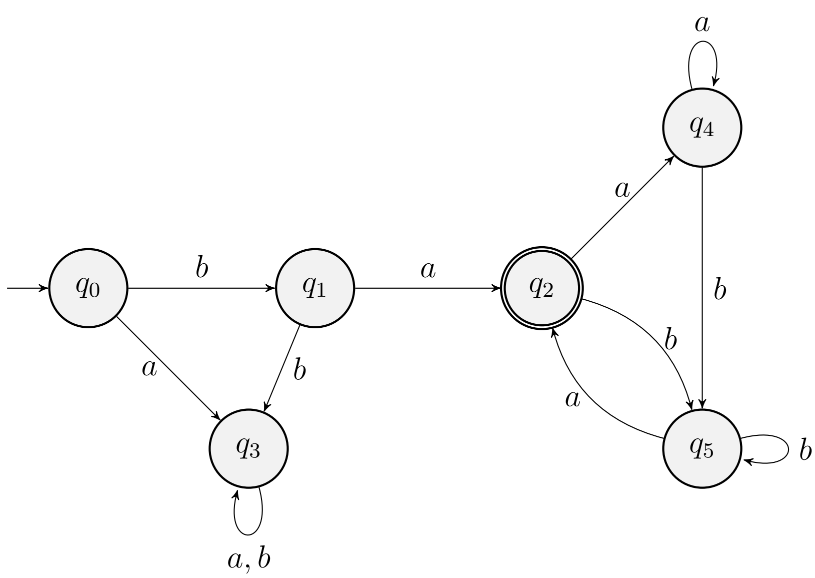
(c) $L_3 = ba(a+b)^*$



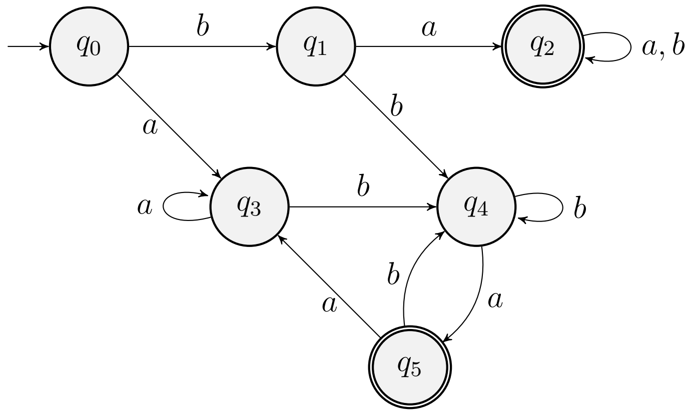
(d) $L_4 = (a+b)^*ba$



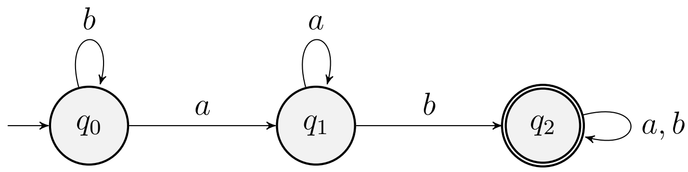
(e) $L_5 = ba((a+b)^*ba + \lambda)$



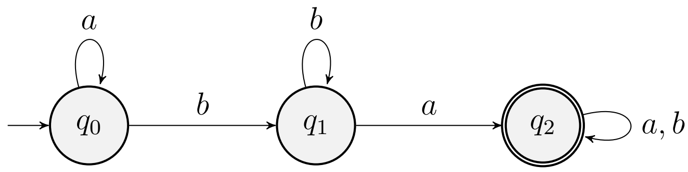
(f) $L_6 = ba(a+b)^* + (a+b)^*ba$



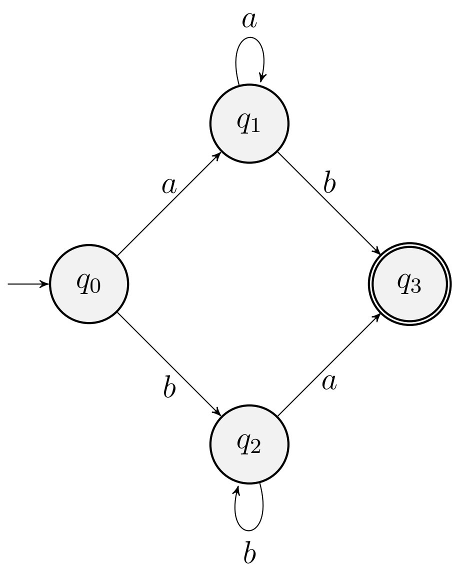
(g) $L_7 = (a+b)^*ab(a+b)^*$



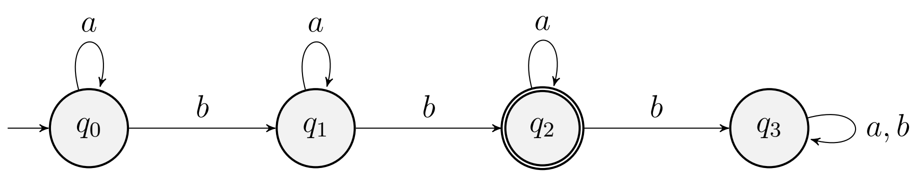
(h) $L_8 = (a+b)^*ba(a+b)^*$



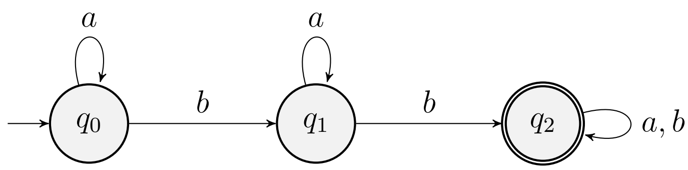
(i) $L_9 = (a+b)^*(ab+ba)(a+b)^*$



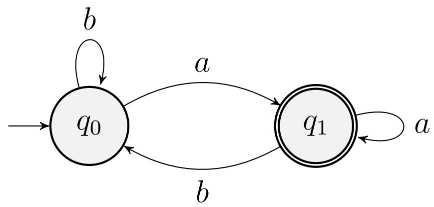
(j) $L_{10} = a^*ba^*ba^*$



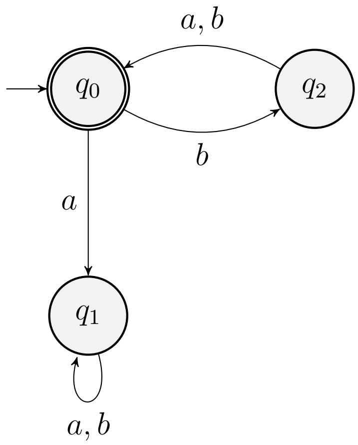
(k) $L_{11} = (a+b)^*b(a+b)^*b(a+b)^*$



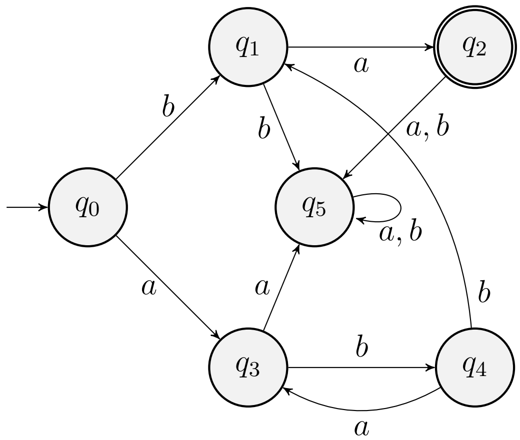
3. (a) $L = (a+b)^*a$



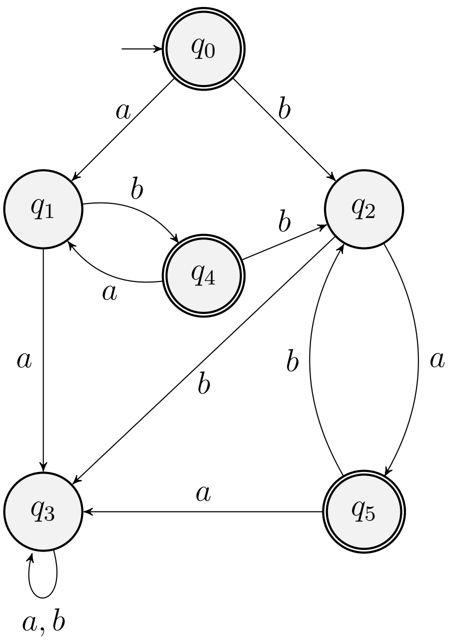
(b) $L = (bb+ba)^*$



(c) $L = (ab)^*ba$



(d) $L = (ab)^*(ba)^*$



(e) $L = (ab^*a)^*$