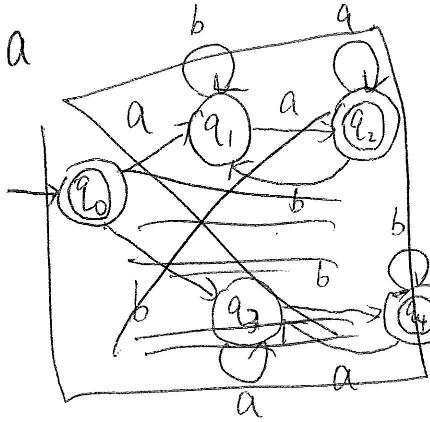
1.a



See page 5

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

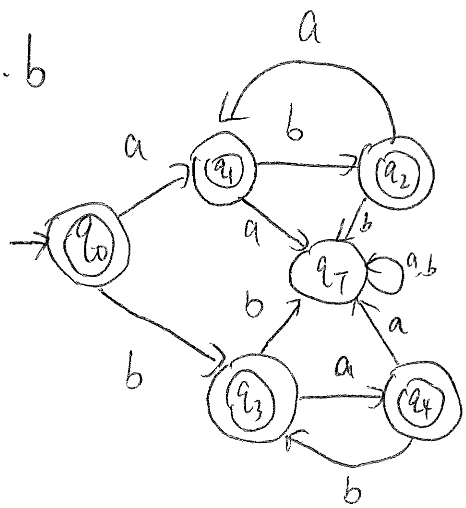
$+ \varepsilon + a + b$

$S \to aA \mid bB \mid \varepsilon \mid a \mid b$

$A \to aA \mid bA \mid a$

$B \to aB \mid bB \mid b$

1.b



$(ab)^*(a+\varepsilon) + (ba)^*(b+\varepsilon)$

~~$S \to aA \mid bB \mid \varepsilon \mid a \mid b$~~

$S \to aA \mid bB \mid \varepsilon$

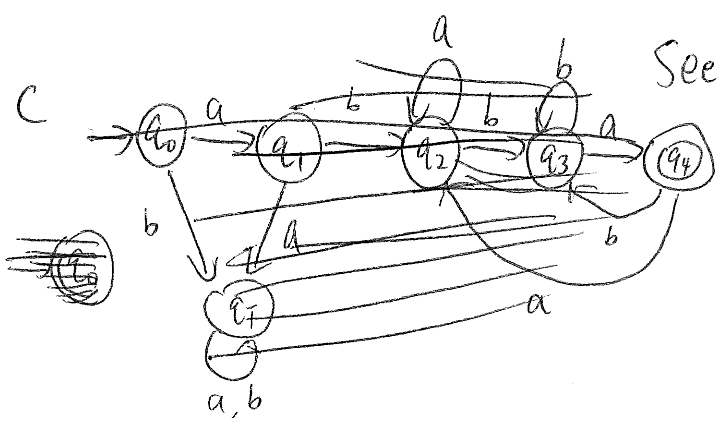
$A \to bC \mid \varepsilon$

$C \to aA \mid \varepsilon$

$B \to aD \mid \varepsilon$

$D \to bB \mid \varepsilon$

1.C



See page 5.

$ab(a+b)^*ba$

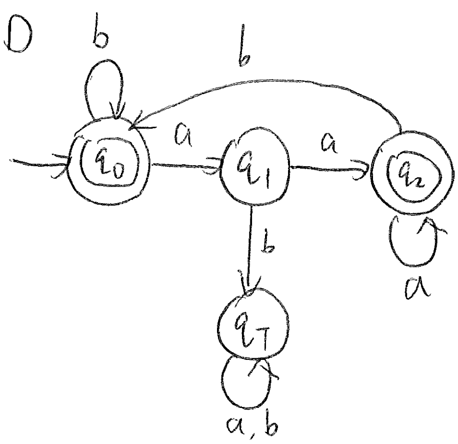
$S \to aA$

$A \to bB$

$B \to aB \mid bB \mid bC$

$C \to a$

1.D

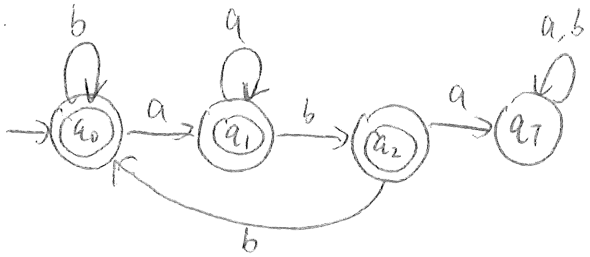


$(b^*aaa^*b^*)^*$

$S \to bS \mid aA \mid \varepsilon$

$A \to aS \mid \varepsilon$

e.



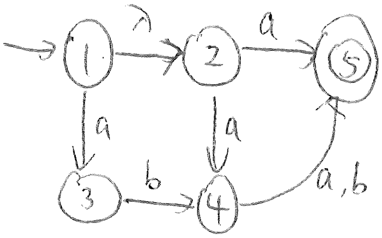
$b^*(a + aa^*bbb^*)^*b^*$

$q_0 \to bq_0 \mid aq_1 \mid \varepsilon$

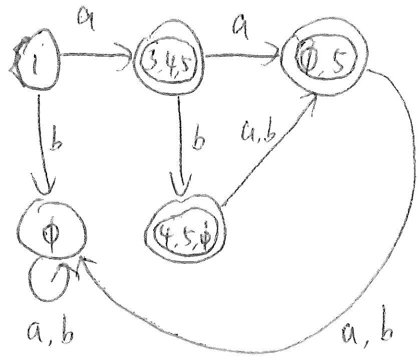
$q_1 \to aq_1 \mid bq_2 \mid \varepsilon$

$q_2 \to bq_0 \mid \varepsilon$

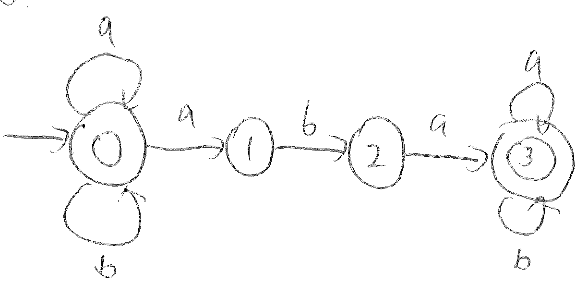
2. a



	a	b
$\{1\}$	$\{3,4,5\}$	$\{\phi\}$
$\{3,4,5\}$	$\{\phi,5\}$	$\{4,5,\phi\}$
$\{\phi\}$	$\{\phi\}$	$\{\phi\}$
$\{\phi,5\}$	$\{\phi\}$	$\{\phi\}$
$\{4,5,\phi\}$	$\{\phi,5\}$	$\{\phi,5\}$



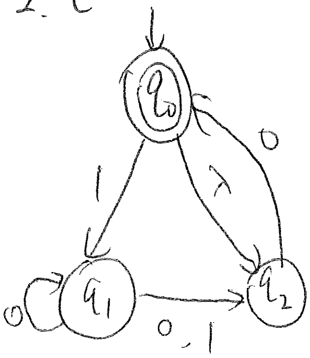
2. b



	a	b
$\{0\}$	$\{0,1\}$	$\{0\}$
$\{0,1\}$	$\{0,1,\phi\}$	$\{0,2\}$
$\{0,1,\phi\}$	$\{0,1,\phi\}$	$\{0,2,\phi\}$
$\{0,2\}$	$\{0,1,3\}$	$\{0,\phi\}$
$\{0,2,\phi\}$	$\{0,1,3,\phi\}$	$\{0,\phi\}$
$\{0,1,3\}$	$\{0,1,3,\phi\}$	$\{0,2,3\}$
$\{0,\phi\}$	$\{0,1,\phi\}$	$\{0,\phi\}$
$\{0,1,3,\phi\}$	$\{0,1,3,\phi\}$	$\{0,2,3,\phi\}$
$\{0,2,3\}$	$\{0,1,3\}$	$\{0,3,\phi\}$
$\{0,2,3,\phi\}$	$\{0,1,3,\phi\}$	$\{0,3,\phi\}$

	a	b
$\{0,3,\phi\}$	$\{0,1,3,\phi\}$	$\{0,3,\phi\}$

2. c



	0	1
$\{q_0\}$	$\{\phi, q_0\}$	$\{q_1, \phi\}$
$\{q_0, \phi\}$	$\{q_0, \phi\}$	$\{q_1, \phi\}$
$\{q_1, \phi\}$	$\{q_1, q_2, \phi\}$	$\{q_2, \phi\}$
$\{q_1, q_2, \phi\}$	$\{q_1, q_2, q_0, \phi\}$	$\{q_2, \phi\}$
$\{q_2, \phi\}$	$\{q_0, \phi\}$	$\{\phi\}$
$\{q_1, q_2, q_0, \phi\}$	$\{q_1, q_2, q_0, \phi\}$	$\{q_2, \phi, q_1\}$
$\{\phi\}$	$\{\phi\}$	$\{\phi\}$

3. a Assume L is regular

1. Let $p=k$

2. Let $w=a^k b^{2k} \in L$

3. $w=xyz$,

a. Let $x=a^{k-m-n}$, $y=a^m$, $z=a^n b^{2k}$, $m>0, n>0$

Let $i=2$, $xy^2z = a^{k-m-n} \cdot a^{2m} \cdot a^n b^{2k} = a^{k+m} b^{2k} \notin L$, contradiction

b. Let $x=a^{k-m}$, $y=a^m$, $z=b^{2k}$, $m>0$

Let $i=2$. $xy^2z = \cancel{a^{k-m} a^{2m} b^{2k}}\ a^{k-m} a^{2m} b^{2k} = a^{k+m} b^{2k} \notin L$ contradiction.

3. b. Assume L is regular

1. Let $p=k$

~~2. Let $w=a^k b^{2k} \in L$~~

2. Let $w=a^k b^{k+2} \in L$

3. $w=xyz$ a. Let $x=a^{k-m-n}$, $y=a^m$, $z=a^n b^{k+2}$, $m,n>0$.

Let $i=2$. $xy^2z = a^{k+m} b^{k+2} \notin L$

b. Let $x=a^{k-m}$, $y=a^m$, $z=b^{k+2}$, $m>0$, Let $i=2$, $xy^2z = a^{k+m} b^{k+2} \notin L$

3.c.

$L = a^*b^*$, regular.

3 D.

Assume L is regular.

1. Let $p = k$.

2. Let $w = a^k b^{2k}$,

3. Same as 3a.

3.e. Assume L is regular

1. Let $p=k$.

2. Let $w = a^k b^k a^k b^k$

~~3. Same as proving $a^k b^k$ not regular.~~

~~3. Let $w = xyz$.~~

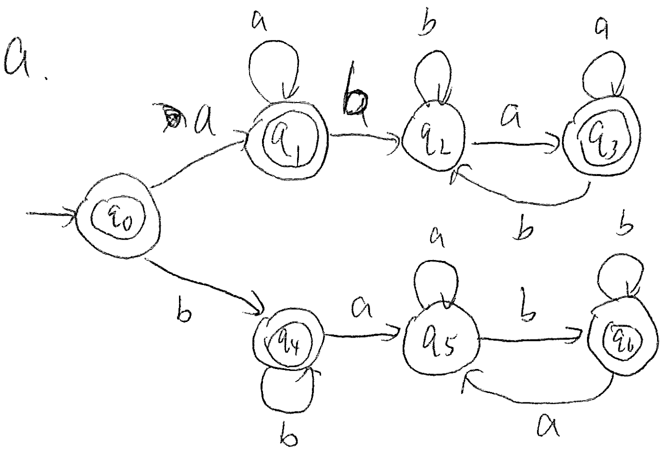
3.a. Let $w = xyz$, $x = a^{k-m-n}$, $y = a^m$, $z = a^n b^k a^k b^k$

Let $i=2$, $xy^2z = a^{k+m} b^k a^k b^k$, because first a^{k+m} is no longer the same length as a^k, $xy^2z \notin L$

b. Let $x = a^{k-m}$ $y = a^m$, $z = b^k a^k b^k$

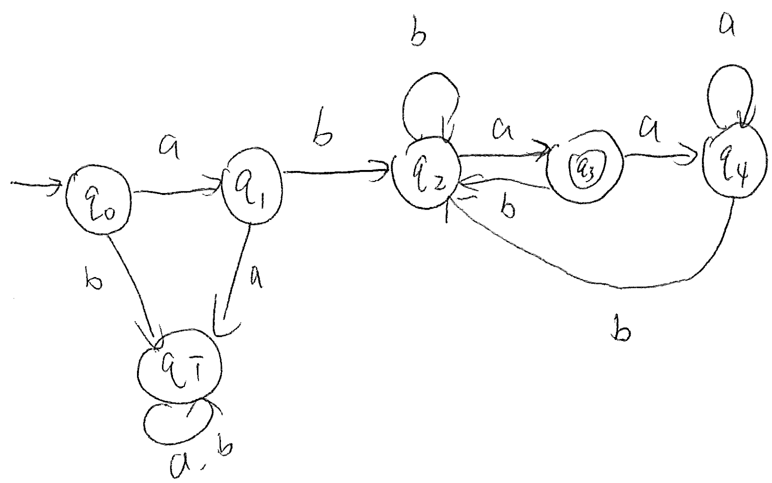
Let $i=2$, $xy^2z = a^{k+m} b^k a^k b^k \notin L$

1. a.



a
b
a
a
b
a
q1
q2
q3
q0
b
a
b
b
a
b
q4
q5
q6
b
a

1. c.



b
a
a
b
a
a
q0
q1
q2
q3
q4
b
b
b
a
qT
a, b