A4

1.

2.

		a	b
z_1	x_1	z_2	z_3
z_2	x_5	z_2	z_2
z_3	x_2	z_4	z_3
z_4	x_2, x_3	z_5	z_6
$+z_5$	x_2, x_3, x_4	z_7	z_6
z_6	x_2, z_2	z_8	z_6
$+z_7$	x_2, x_3, x_4	z_7	z_6
z_8	x_2, x_3, z_2	z_7	z_6

$x_2 \ x_3$
$a \downarrow$
x_2, x_3, x_4

x_2, x_3, x_4
$\downarrow a$
x_2, x_3, x_4, z_2

x_2, z_2
$\downarrow a$
x_2, x_3, z_2

x_2, x_3
$b \downarrow$
x_2, z_2

x_2, x_3, x_4
$\downarrow b$
x_2, z_2

x_2, z_2
$\downarrow b$
x_2, z_2

x_2, x_3, z_3
$\downarrow a$
x_2, x_3, x_4

x_2, x_3, x_4
$\downarrow a$
x_2, x_3, x_4

x_2, x_3, x_4, z_2

x_2, x_3, x_4, z_2

baabb ac
b caa aa
b bbaa aa
bb aa0
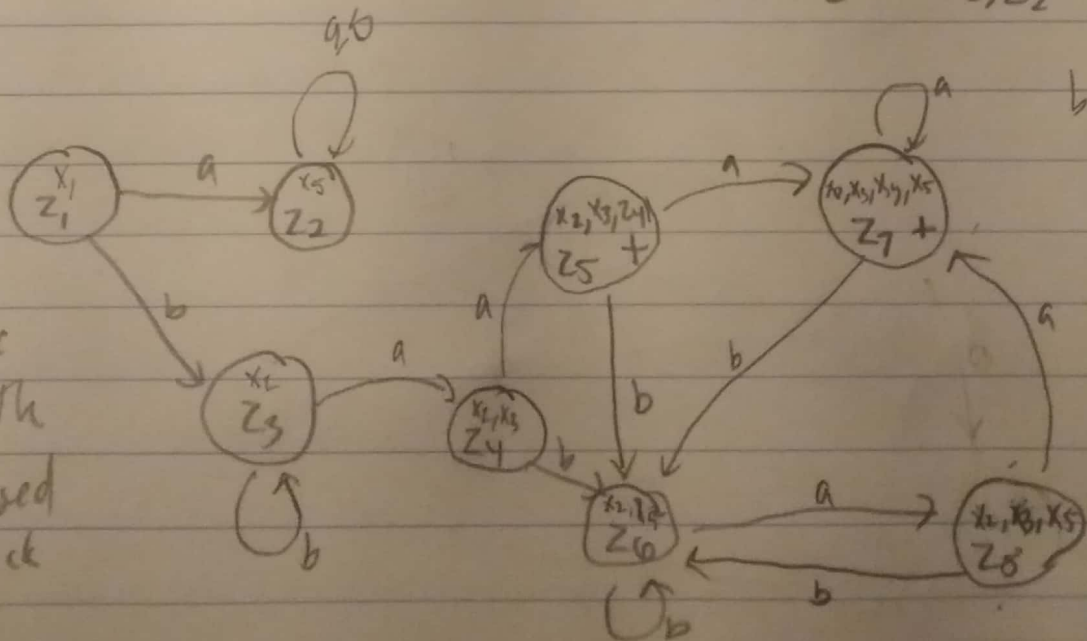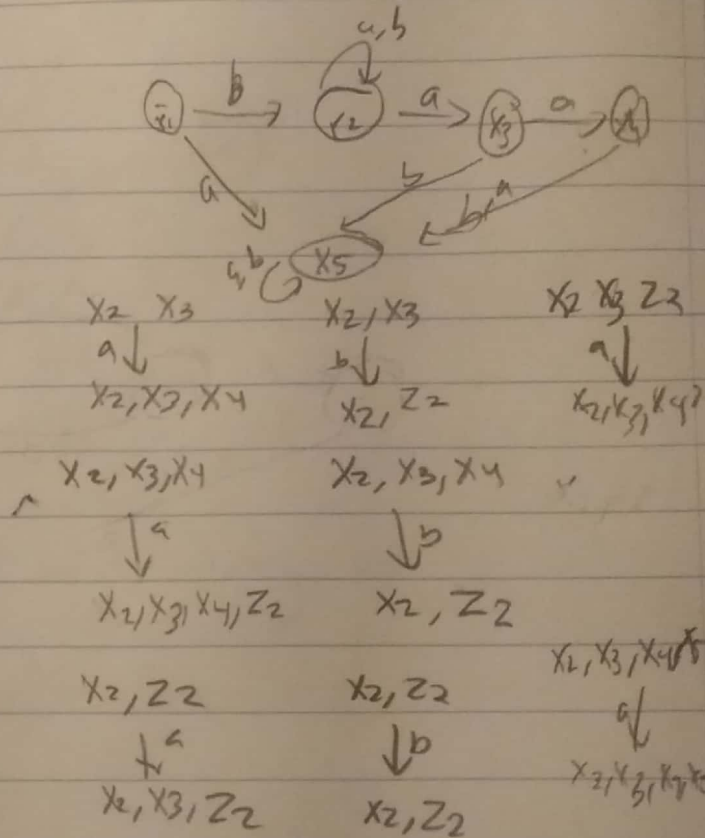
* Please ignore
the x's in the
diagram, I used
them to check
my work.

3.

$q_0/0$ 1 $q_1/1$

0   0

1

4.

$a/1$

q_2

$b/0$ $a/0$

$b/1$

$a/1$ q_1

q_0

$b/0$

$a/1$

q_c

$b/0$
$b/0$

$a/0$

$q_a^2/1$

a

$q_v/1$

$q_d^1/0$ b

a

$q_2^a/1$

a

b
b a $q_2/0$ a

b

$q_0^a/1$ a a $q_v/1$

a

$q_0^1/0$ b
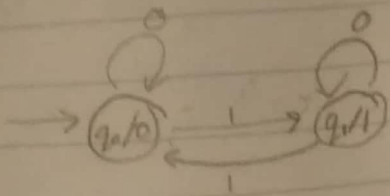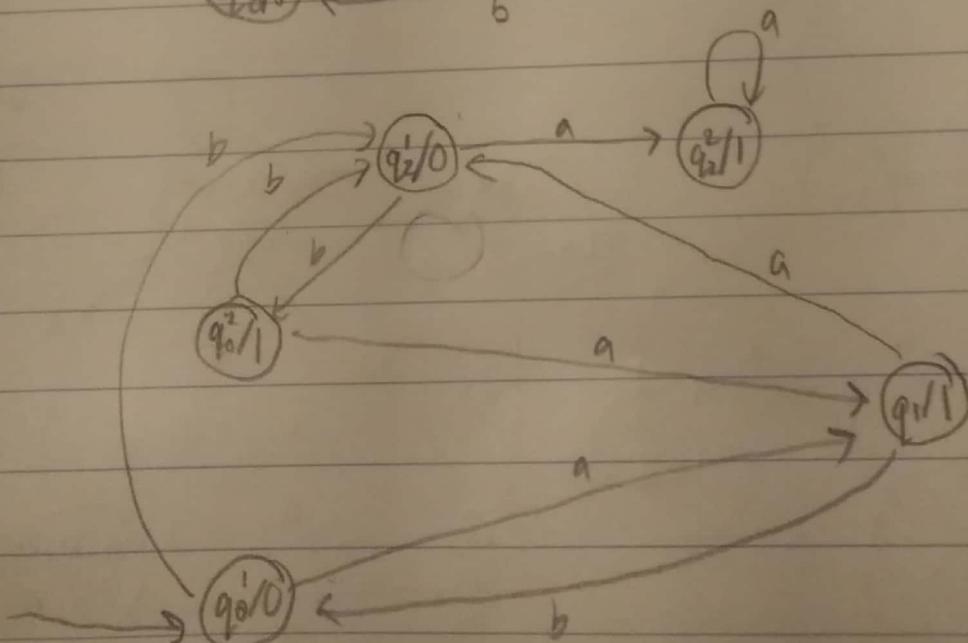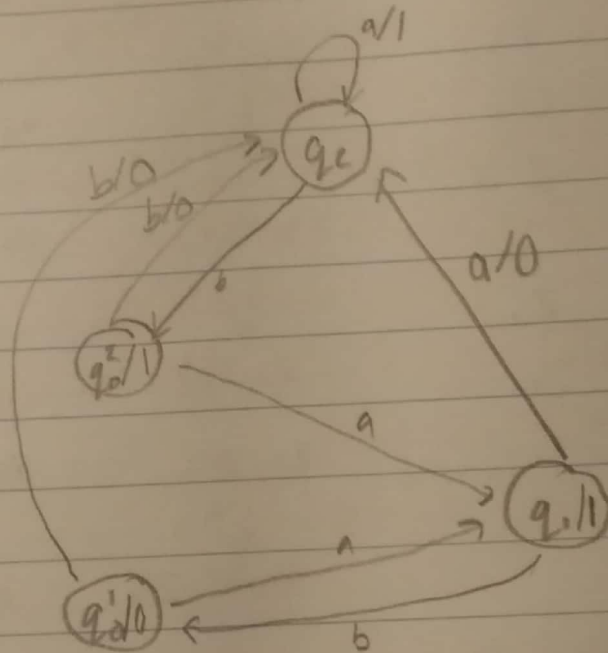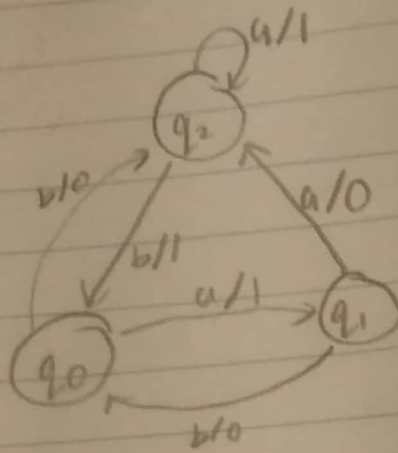
5. a) False, below is a counter example
$L_2 = a^*$ which is regular
$L_1 = a^N$ where N is a prime, which is not regular
L_1 is contained in L_2 as a^* can be any number of a's including all prime numbers
b) False, below is a counter example
$L_2 = a^N$ where N is a prime, which is not regular
$L_1 = a$, which is regular
L_1 is contained in L_2 as $a^1 = a$.
c) False, below is a counter example
$L_1 = a^N$ where N is a prime, which is not regular
$L_2 = b^N$ where N is a prime, which is not regular
$L_1 \cap L_2 = \triangle$, which is regular

d) True, proof by contradiction.
L is nonregular, Suppose L' is regular.
As L' is regular, L'' must be regular (see proof that the
complement of a regular language is also regular on slide 11 of chp 9).
As $L'' = L$, L must be regular which is a contradiction
Therefore, L' is nonregular