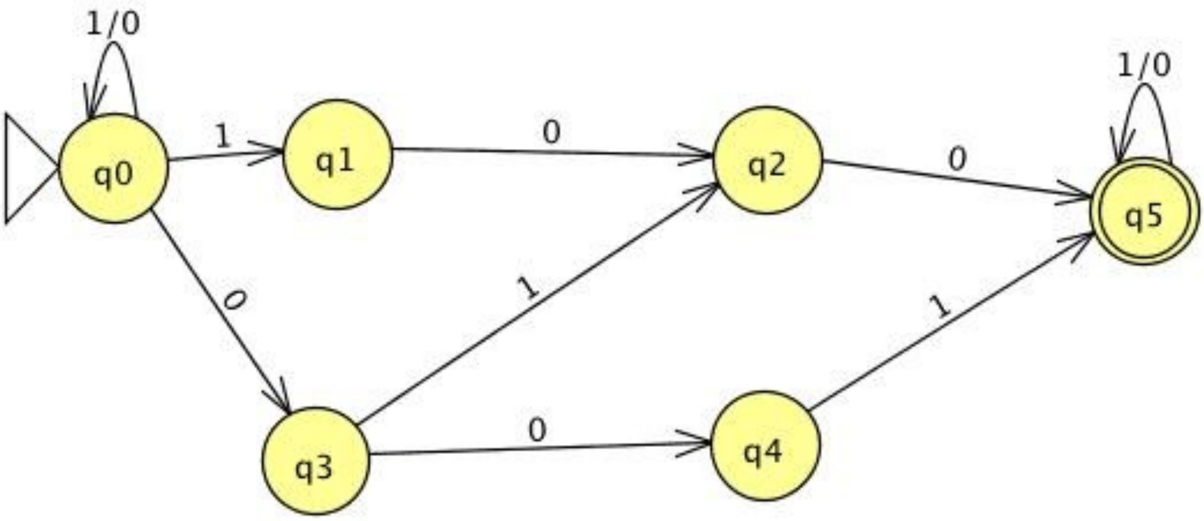
Q1:

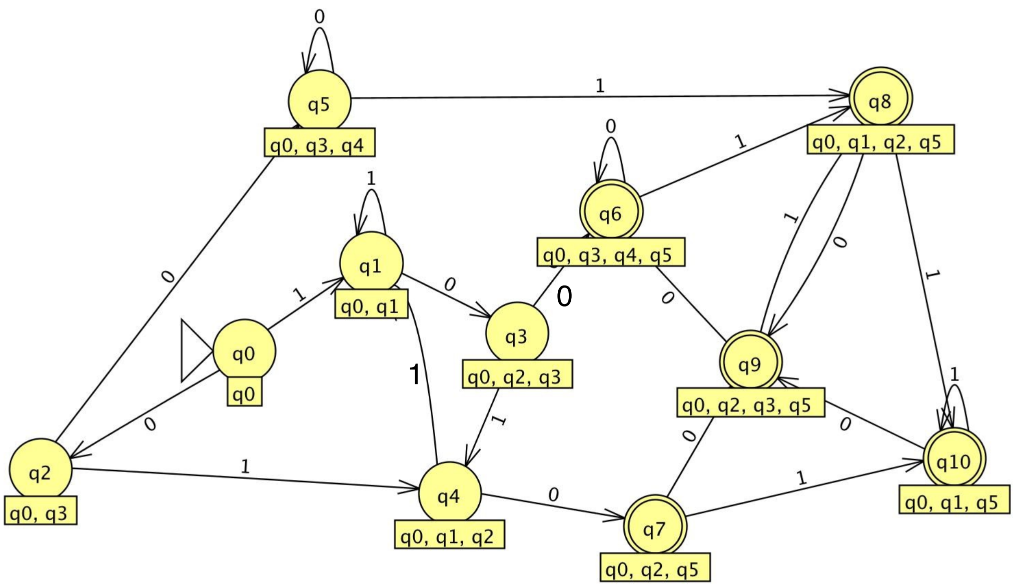
The NFA for the RE is:



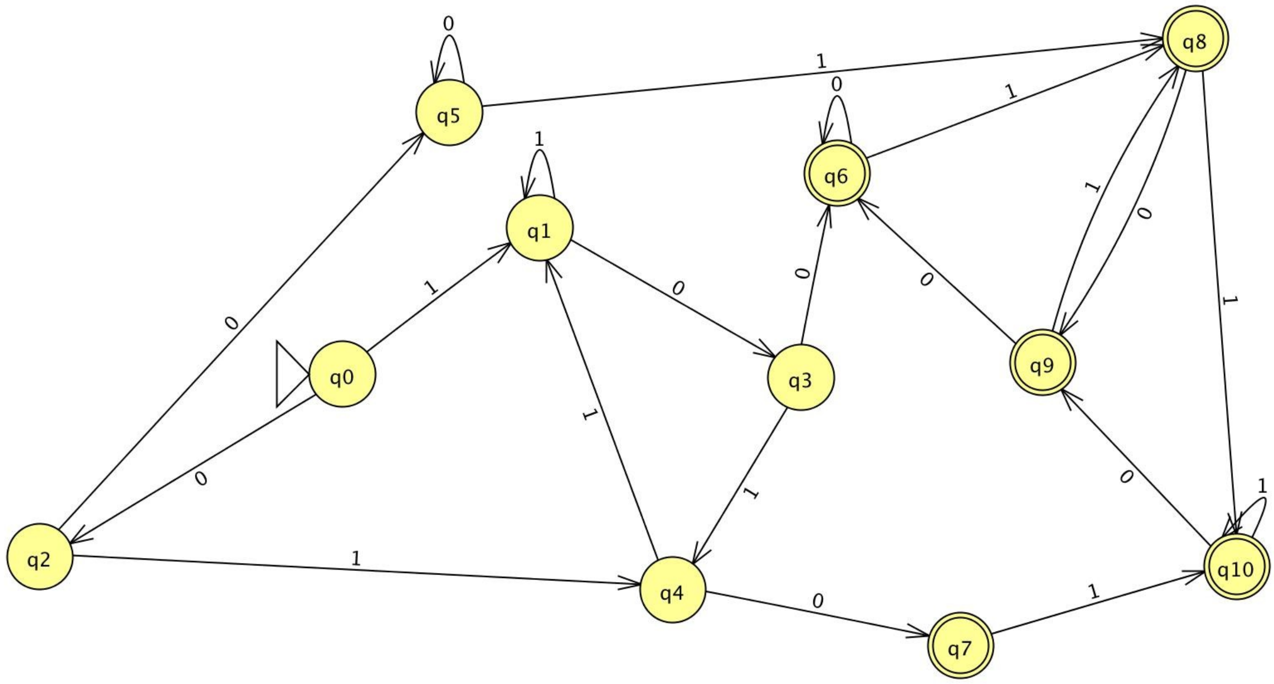
The $\mathcal{E}$-closure(q0)={q0}, therefore, we have the following table:

State	1	0
{q0}	{q0, q1}	{q0, q3}
{q0, q1}	{q0, q1}	{q0, q2, q3}
{q0, q3}	{q0, q1, q2}	{q0, q3, q4}
{q0, q2, q3}	{q0, q1,q2}	{q0, q3, q4, q5}
{q0, q1, q2}	{q0, q1}	{q0, q2, q5}
{q0, q3, q4}	{q0, q1, q2, q5}	{q0, q3, q4}
{q0, q3, q4, q5}	{q0, q1, q2, q5}	{q0, q3, q4, q5}
{q0, q2, q5}	{q0, q1, q5}	{q0, q2, q3, q5}
{q0, q1, q2, q5}	{q0, q1, q5}	{q0, q2, q3, q5}
{q0, q2, q3, q5}	{q0, q1, q2, q5}	{q0, q3, q4, q5}
{q0, q1, q5}	{q0, q1, q5}	{q0, q2, q3, q5}

Therefore, the DFA for this RE is:



DFA without description:



Q2:

We prove by contradiction, assume that L' is a regular language, then since RLs are closed under complement, so the complement of L' is also a RL, but the complement of L' is $L=\{0^n1^n \mid n \geq 0\}$, which is known to be a non regular language, this brings a contradiction.

Therefore, L' is not a regular language. Q.E.D.

Q3:

The DFA specifies a regular language defined as follow: a language that has odd number of a and even number of b, or has even number of a and odd number of b.

A simplified version is: a language constructed by {a, b}*, of which each string has an odd number of characters.

Therefore, the RE for the language is: (a|b)((aa|bb)*(ab|ba)*)*

Q4:

Proof:

because the keene-star of L is defined as: $L^*=\{\mathcal{E}\}\cup L\cup L_2\cup\ldots$, where $L_{i+1}=\{wv \mid w \in L_i, v \in L\}$

and $L_0^*=\{\mathcal{E}\}\cup L_0\cup L_{02}\cup\ldots$, where$L_{0(i+1)}=\{w'v' \mid w' \in L_{0i}, v' \in L_0\}$

since $L_0\subseteq L$, L contains all strings that are in L_0, and hence $w' \in L^*$, $v' \in L^*$, and so does w'v'

$\therefore$ L^* also contains L_0^*

$\therefore$ $L_0^*\subseteq L^*$ Q.E.D.

Q5:

L_P^* is a regular language. Proof:

Claim 1: $L_P^*=\{a^n \mid n =0, 2, 3, 4, \ldots\}$

proof: if a^n has a length of an even number, then $a^n=(a^2)^i$, where i=0, 1, 2, 3, …

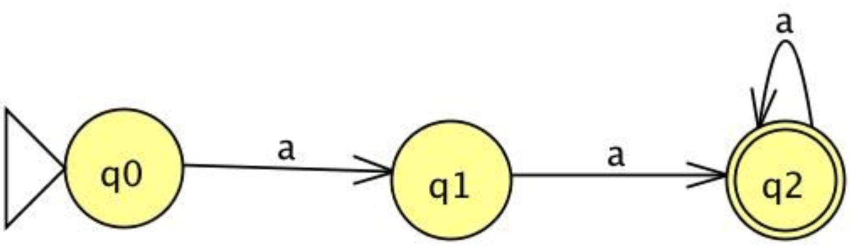
if a^n has a length of an odd number which is greater than 1, then $a^n=(a^3)(a^2)^i$, where i=0, 1, 2, 3, …

Therefore: $L_P^*=\{a^n \mid n = 2, 3, 4, \ldots\}$

Claim 2: L_P^* can be expressed by a DFA

proof: $L_P^*=\{a^n \mid n = 2, 3, 4, \ldots\}$ can be expressed by a 3-state DFA:

The following DFA accepts $L_P^*=\{a^n \mid n =0, 2, 3, 4, \ldots\}$



Since a language can be expressed by a DFA is equivalent to the language is regular, then therefore L_P^* is regular. Q.E.D.