1. Exercise 1 on page 184.

Solution:
(a) The state diagram of $M$ is

(b) i) $[q_0, abaa]$  
   $\vdash [q_0, baa]$  
   $\vdash [q_1, aa]$  
   $\vdash [q_2, a]$  
   $\vdash [q_2, \lambda]$  

   ii) $[q_0, bbbabb]$  
       $\vdash [q_1, bbabb]$  
       $\vdash [q_1, babb]$  
       $\vdash [q_1, abb]$  
       $\vdash [q_2, bb]$  
       $\vdash [q_0, b]$  
       $\vdash [q_1, \lambda]$  

   iii) $[q_0, bababa]$  
        $\vdash [q_1, ababa]$  
        $\vdash [q_2, bab]$  
        $\vdash [q_0, aba]$  
        $\vdash [q_0, ba]$  
        $\vdash [q_1, a]$  
        $\vdash [q_2, \lambda]$  

   iv) $[q_0, bbbaa]$  
        $\vdash [q_1, bbbaa]$  
        $\vdash [q_1, baa]$  
        $\vdash [q_1, aa]$  
        $\vdash [q_2, a]$  
        $\vdash [q_2, \lambda]$  

(c) The computations in i, iii and iv terminate in the accepting state $q_2$. Therefore the strings $abaa$, $bababa$ and $bbbaa$ are in $L(M)$. 

1
(d) Two regular expressions describing \( L(M) \) are \( a^*b^+a^+(ba^*b^+a^+)^* \) and \( (a^*b^+a^+b^*)a^*b^+a^+ \). (20 points)

2. Exercise 11 on page 185.

Solution:

The state diagram of a DFA is

![State Diagram](image)

(20 points)

3. Exercise 12 on page 185.

Solution:

The state diagram of a DFA is

![State Diagram](image)

(20 points)
4. Design an NFA that accepts the following language over the alphabet \( \{a, b\} \):

\[(abc)^*(ab)^*\]

**Solution:**

The state diagram of an NFA is

![NFA Diagram](image)

(20 points)

5. Exercise 36 on page 187.

**Solution:**

(a) \( \lambda - \text{closure}(q_0) = \{q_0, q_2\} \).

(b) The input transition function \( t \) is the following:

<table>
<thead>
<tr>
<th>( t )</th>
<th>a</th>
<th>b</th>
<th>c</th>
</tr>
</thead>
<tbody>
<tr>
<td>( q_0 )</td>
<td>{q_0, q_2}</td>
<td>{q_1, q_2}</td>
<td>{q_1}</td>
</tr>
<tr>
<td>( q_1 )</td>
<td>\emptyset</td>
<td>\emptyset</td>
<td>{q_1}</td>
</tr>
<tr>
<td>( q_2 )</td>
<td>\emptyset</td>
<td>{q_1, q_2}</td>
<td>\emptyset</td>
</tr>
</tbody>
</table>

(c) The equivalent DFA:
(d) A regular expression is $a^*b^*c^*$. (20 points)