1. *(10 points)* Let $L$ over $\Sigma = \{1, 2, 3, a, b, c, -\}$ be the language of names where every name has to begin with a letter ($a$, $b$, or $c$). The dash character ($-$) always has to be followed by another non-dash character.

   (a) Give a recursive definition for $L$.
   (b) Give a regular expression for $L$.

2. *(75 points)* Give a regular expression for the following languages.

   (a) The set of strings over $\{1, 2, 3, a, b, c\}$ that start and end with a number. Strings can have a length of 1 or greater.

   (b) The set of strings over $\{1, 2, 3, a, b, c\}$ that contain exactly two numbers and the sum of the numbers is even.

   (c) The set of strings over $\{a, b, c\}$ in which all the $a$’s precede the $b$’s, which in turn precede the $c$’s. It is possible that there are no $a$’s, or $b$’s, or $c$’s and the string is empty.

   (d) The set of strings over $\{a, b, c\}$ in which all the $a$’s precede the $b$’s, which in turn precede the $c$’s. It is possible that there are no $a$’s, or $b$’s, or $c$’s, but $\lambda$ is not in the language.

   (e) The set of strings over $\{1, 2, 3, a\}$ that do not begin with 123.

3. *(15 points)* The following DFA $M_1$ accepts all strings that end in ‘$ab$’.

   Give a 5-tuple that formally describes the DFA.

   ![Diagram of DFA M1](image-url)