1. Suppose we roll a fair six-sided die until a six comes up.
   (a) What is the probability that we roll the die \( n \) times?
   (b) What is the expected number of times we roll the die?

2. Let \( s \) be a randomly generated bit string of length six.
   (a) Let \( X \) be the random variable equal to the number of ones in \( s \) minus the number of zeros in \( s \).
       What is the expected value of \( s \).
   (b) Let \( Y \) be the random variable equal to the sum of the first two bits in \( s \). What is the expected value and variance of \( Y \).

3. Consider the language \( L = \{ y^k x y^\ell \mid k \geq 1, \ell \geq 2 \} \), over the alphabet \( \Sigma = \{ x, y, z \} \).
   (a) Construct a DFA that accepts this language.
   (b) Give a regular expression that describes this language.

4. Consider the language \( L = \{ w \mid w \text{ is of the form } 10^k1, \text{ where } k \text{ is a positive even number} \} \). The alphabet is \( \Sigma = \{ 0, 1 \} \).
   (a) Give a regular expression that describes this language.
   (b) Construct an NFA that accepts this language.