1. Consider the experiment of placing three distinguishable particles a, b, and c into three cells. Examples of sample points are \( \omega_1 = (abc | - | -) \), \( \omega_2 = (ab| c | -) \), etc.
   a. Write down the sample space \( \Omega \).
   b. Define events as:
      - \( A \) = multiple particles occupy a cell
      - \( B \) = the last cell is not empty
      - \( C \) = \( A \) occurs but not \( B \).
      How many sample points are there in events \( A \), \( B \), and \( C \) respectively?
   c. Assuming equal probability for each outcome, calculate the probability of events \( A \), \( B \), and \( C \).

2. A complex number is selected uniformly at random in the sample space \( S = \{ c = a + jb : |a| \leq 1, \ |b| \leq 1 \} \), where \( a \) and \( b \) are the real and image part of the complex number respectively. Let the events \( A = \{ a \geq 0 \} \), \( B = \{ 0.25 \leq |b - 0.25| \leq 0.75 \} \) and \( C = \{ |c| = \sqrt{a^2 + b^2} \leq 1 \} \). Compute:
   a. \( P( A ) \)
   b. \( P( B ) \)
   c. \( P( C ) \)
   d. \( P( A \cap B ) \)
   e. \( P( A \cup C ) \)
   f. \( P( A \cap B \cap C ) \)

3. Let \( A \), \( B \), and \( C \) be events in sample space \( S \).
   a. Using axioms and laws of probability prove that \( P( A \cap B \cap C ) \leq P( A \cup B \cup C ) \leq P( A ) + P( B ) + P( C ) \).
   b. Using Venn diagrams prove the same relationship.

4. A number is selected uniformly at random from the set of integers \( \{-100, -99, \ldots, -1, 0, 1, \ldots, 99, 100\} \). What is the probability that it is divisible by 6 or 7, but neither by 2 nor by 5?