Problem 1. Suppose that S is a set with n elements and a and b are positive integers such that $a + b = n$. Prove that the number of partitions of S into two parts of sizes a and b is

$$\begin{cases} \binom{n}{a} & \text{if } a \neq b, \text{ and} \\ \frac{1}{2}\binom{n}{a} & \text{if } a = b. \end{cases}$$

Problem 2. Suppose that S is a set with n elements and a, b, and c are positive integers with $a + b + c = n$. Find a formula for the numbers of partitions of S into three parts of sizes a, b, and c. Give some justification for your formula; it does not have to be a fully rigorous proof.