Basic rules of probability

1. An event occurs with probability between 0 and 1, inclusive. If A is an event, then

$$0 \leq P(A) \leq 1.$$

2. The sample space always occurs, i.e., the outcome is always in the sample space, so

$$P(S) = 1.$$

3. Consider a sequence of events A_1, A_2, A_3, $\ldots$, and the events are pairwise disjoint, i.e., A_i and A_j have no outcome in common (for each i, j), then we can add the probabilities of the events to get the probability of the union. In other words,

$$P\left(\bigcup_{j=1}^{\infty} A_j\right) = \sum_{j=1}^{\infty} P(A_j).$$

Here the sequence of events is infinite, i.e., we have infinitely many events we are considering.