Rule # 1: In all cases,
$$0 \leq \Pr(E) \leq 1$$

Rule # 2: S is a set of events. $S = \{E_1, E_2, E_3, \ldots E_k\}$. If the events in S are mutually exclusive **and** S is exhaustive (every possible outcome is considered in the events in S), then:
$$\sum_{i=1}^{k} \Pr(E_i) = 1$$

Definition: Two events are **mutually exclusive** if they cannot both occur in the same trial:
$$\Pr(A \text{ and } B) = 0 \text{ if } A \text{ and } B \text{ are mutually exclusive}$$

Rule # 3: If A and B are mutually exclusive then
$$\Pr(A \text{ or } B) = \Pr(A) + \Pr(B)$$

Rule # 4: The event "not A" means "any event other than A occurs"
$$\Pr(\text{not } A) = 1 - \Pr(A)$$

Rule # 5: The **general addition rule**:
$$\Pr(A \text{ or } B) = \Pr(A) + \Pr(B) - \Pr(A \text{ and } B)$$

Rule # 6: If A and B are independent events then:
$$\Pr(A \text{ and } B) = \Pr(A) \Pr(B)$$

Definition: If knowing that one event occurs tells you nothing about the probability of a second event, then the two events are **independent** of each other.
$$\Pr(A|B) = \Pr(A|\text{not } B) = \Pr(A) \text{ if } A \text{ and } B \text{ are independent}$$

Rule # 7: The **general multiplication rule**:
$$\Pr(A \text{ and } B) = \Pr(A) \Pr(B|A) = \Pr(B) \Pr(A|B)$$

Rule # 8: Bayes' theorem:
$$\Pr(A|B) = \frac{\Pr(A) \Pr(B|A)}{\Pr(B)}$$

Rule # 9: Law of total probability. If $S = \{E_1, E_2, E_3, \ldots E_k\}$, the events in S are mutually exclusive, and S is exhaustive:
$$\Pr(A) = \sum_{i=1}^{k} \Pr(A|E_i) \Pr(E_i)$$

General "Recipe" for solving probability problems.

You'll be given data from which you can extract probability statements.

You'll be asked to calculate a result (another probability statement, or a conclusion that relies on the calculation of a probability).

1. Write down the data and the quantity to be calculated in the correct notation:
   - What is the event that the probability statement applies to?
   - What is the sample space that the event is a part of?
   - Does the probability statement only apply to a special case of the entire realm of events? – In other words, is it a *conditional* probability statement (one that only applies in some cases)? If so, write it as a conditional probability statement.

2. Use the appropriate probability rules to solve for what you need to calculate.