A Fundamental Principle of Counting

Cardinality of a Set

- The **cardinality** of a set refers to how many elements are in the set.
- If $S$ is any set, we will denote the number of elements in $S$ by $n(S)$.

**EXAMPLE**
- Let $S = \{2, 4, 6, 8, 10\}$. Find $n(S)$.
- Let $S = \emptyset$. Find $n(S)$.

Inclusion-Exclusion Principle (Union Rule)

- Let $S$ and $T$ be sets. Then,
  $n(S \cup T) = n(S) + n(T) - n(S \cap T)$

**EXAMPLES**
- Find $n(S \cap T)$, given that $n(S) = 4$, $n(T) = 12$, and $n(S \cup T) = 15$.
- Find $n(T)$, given that $n(S) = 14$, $n(S \cap T) = 6$, and $n(S \cup T) = 14$.

Example: Course Enrollments

- Suppose that all of the 1000 first-year students at a certain college are enrolled in a math or an English course. Suppose that 400 are taking both math and English and 600 are taking English. How many are taking a math course?

Venn Diagrams

- Sets can be visualized geometrically by drawings known as **Venn diagrams**.

Shading Venn Diagrams

- Shading different regions of the rectangle can illustrate a number of sets.
- For each of the following, draw a Venn diagram and shade the portion corresponding to the set.
  a.) $S \cap T$
  b.) $S \cup T$
Shading Venn Diagrams cont.

• For each of the following, draw a Venn diagram and shade the portion corresponding to the set.

  c.) $S' \cap T'$

  d.) $R \cap (S \cup T)$