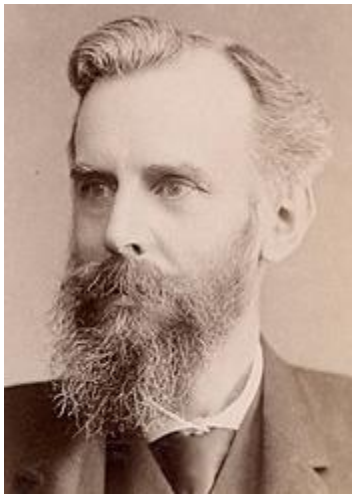
Set Operations and Venn Diagrams:

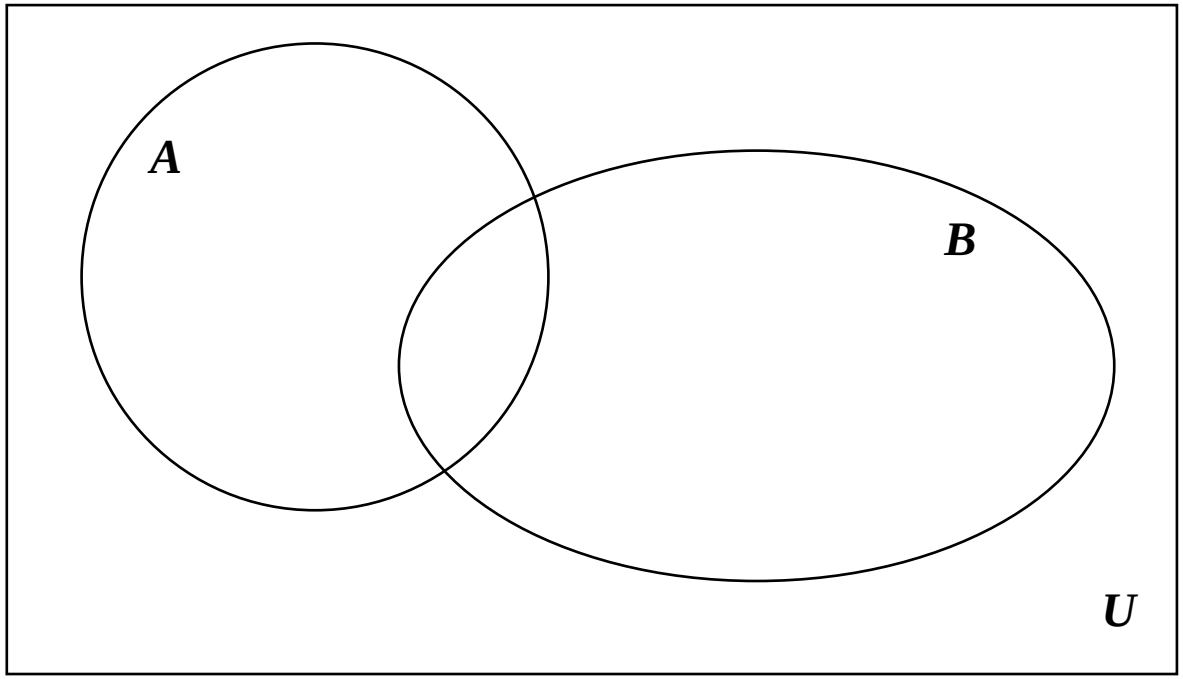
In a particular problem or situation, the set of all objects under consideration is called a universal set. It is abbreviated with the letter *U*, and represented in a Venn diagram as a large square or rectangle.



All the objects under consideration

U

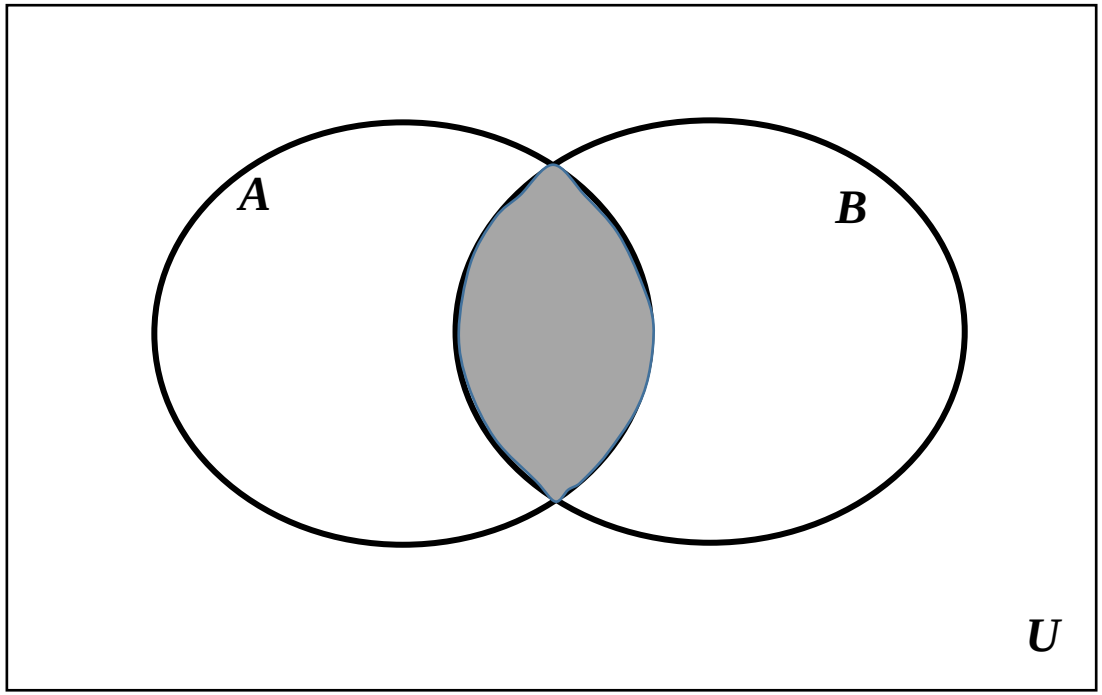
Sets of objects in a universal set are represented by circles or ovals.



Set Intersection:

The intersection of sets *A* and *B*, written as $A \cap B$, is the set of elements common to both set *A* *and* set *B*. In other words, it's the objects shared by the two sets.

$A \cap B$ is represented in a Venn diagram as the shaded region, the region of overlap of the two ovals.



Examples: $A=\{1,2,3,4,5,6\}$ $B=\{2,3,4,5,7\}$ $C=\{5,8\}$ $D=\{1,2,3\}$

List the elements in the following sets:

$A \cap B$

$\{2,3,4,5\}$

$B \cap C$

$\{5\}$

$A \cap C$

$\{5\}$

$C \cap D$

ϕ

$A \cap \phi$

ϕ

$A \cap B \cap C$

$\{5\}$

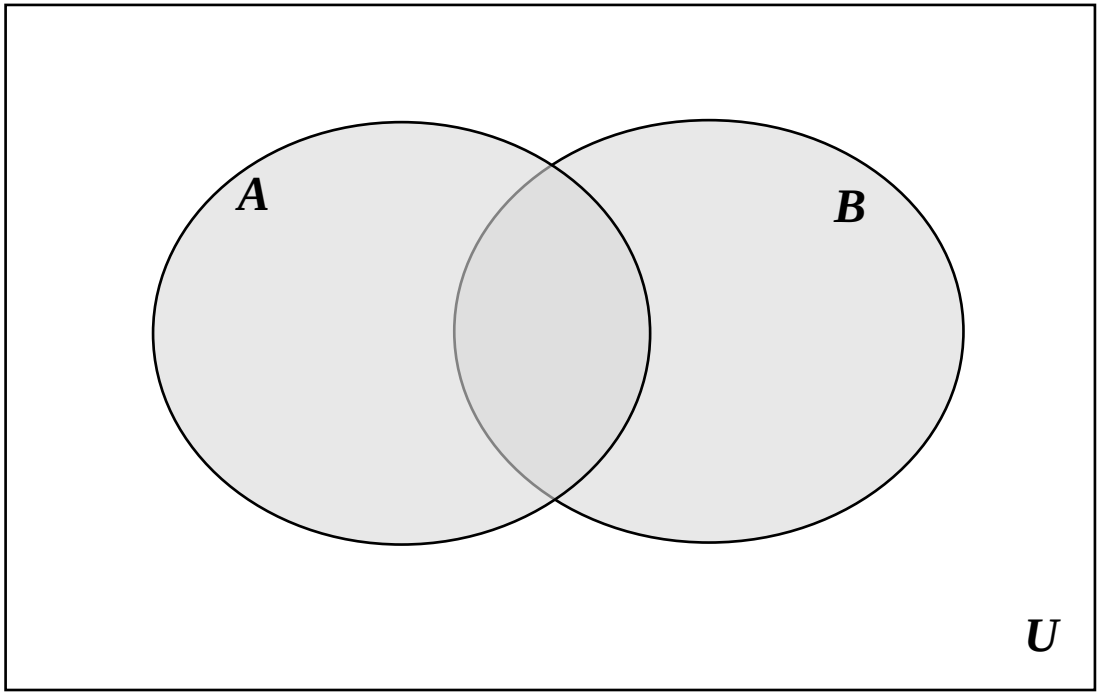
$C \cap C$

$\{5,8\}$

Set Union:

The union of sets *A* and *B*, written as $A \cup B$, is the set of elements that are in set *A* *or* in set *B*, *or* in both. In other words, it's the elements of both sets combined into one.

$A \cup B$ is represented in a Venn diagram as the shaded region below. It's formed by joining the regions inside the ovals.



Examples: $A=\{1,2,3,4,5,6\}$ $B=\{2,3,4,5,7\}$ $C=\{5,8\}$ $D=\{1,2,3\}$

List the elements in the following sets:

$A \cup B$

$\{1,2,3,4,5,6,7\}$

$C \cup D$

$\{1,2,3,5,8\}$

$\phi \cup D$

$\{1,2,3\}$

$A \cap (C \cup D)$

$\{1,2,3,4,5,6\} \cap \{1,2,3,5,8\}$

$\boxed{\{1,2,3,5\}}$

$A \cup B \cup C$

$\{1,2,3,4,5,6,7,8\}$

$(B \cap C) \cup (A \cap D)$

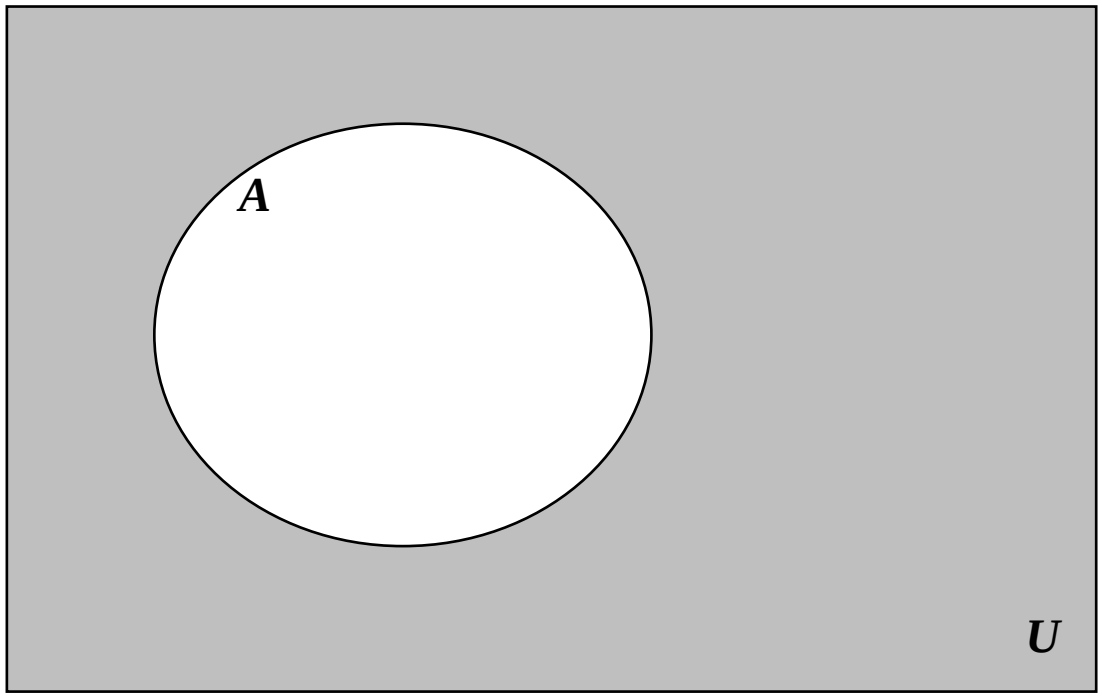
$\{5\} \cup \{1,2,3\}$

$\boxed{\{1,2,3,5\}}$

Set Complement:

The complement of the set *A*, written A', is the set of all objects in the universe that are *not* in the set *A*. In other words it's the opposite of *A*.

A' is represented in a Venn diagram as the shaded region below. It's the region outside of the oval.



Examples: $A=\{1,2,3,4,5,6\}$ $B=\{2,3,4,5,7\}$ $C=\{5,8\}$ $D=\{1,2,3\}$

$U=\{1,2,3,4,5,6,7,8\}$

List the elements in the following sets:

A'

$\{7,8\}$

B'

$\{1,6,8\}$

$(A\cap B)'$

$\{2,3,4,5\}'$

$\boxed{\{1,6,7,8\}}$

$(A\cup B)'$

$\{1,2,3,4,5,6,7\}'$

$\boxed{\{8\}}$

$B'\cap C$

$\{1,6,8\}\cap\{5,8\}$

$\boxed{\{8\}}$

$(A\cap B)'\cup C$

$\{1,6,7,8\}\cup\{5,8\}$

$\boxed{\{1,5,6,7,8\}}$

$A'\cap B'$

$\{7,8\}\cap\{1,6,8\}$

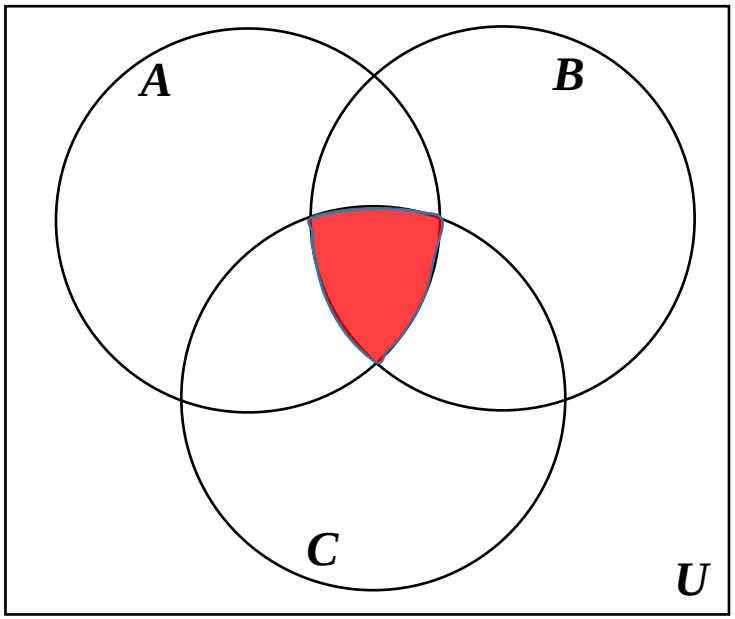
$\boxed{\{8\}}$

$A'\cup B'$

$\{7,8\}\cup\{1,6,8\}$

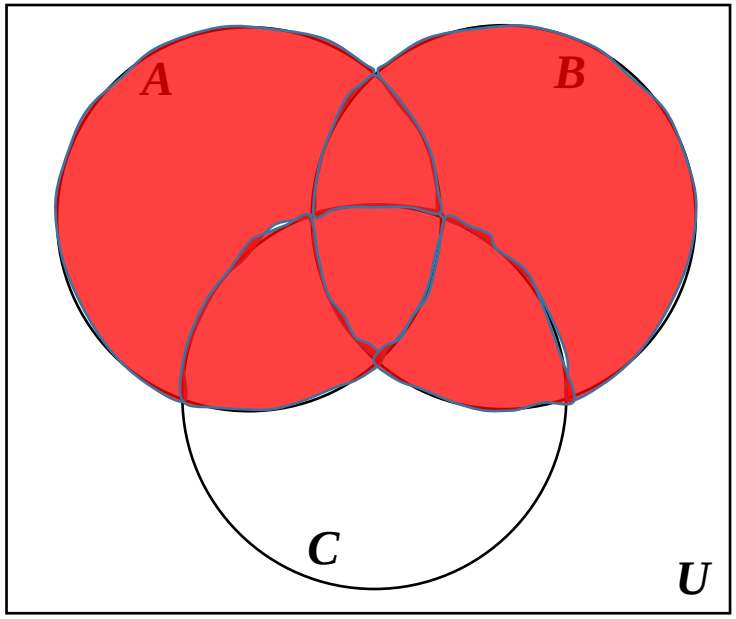
$\boxed{\{1,6,7,8\}}$

Shade the region(s) that is represented by the following set operations.



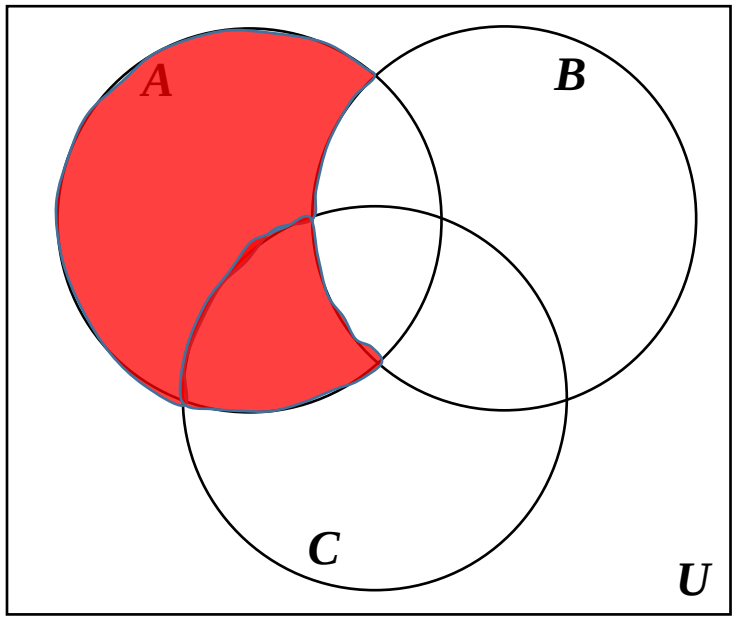
$A \cap B \cap C$

Inside all 3 circles



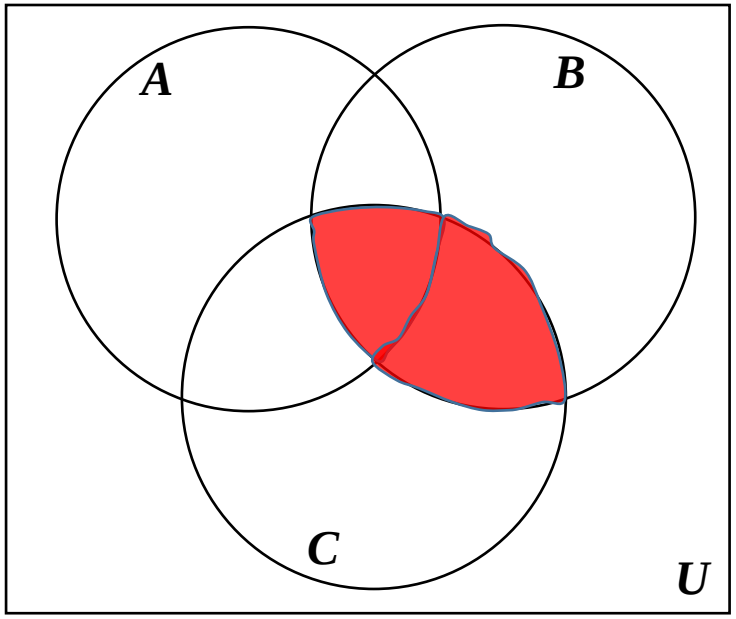
$A \cup B$

A circle and B circle combined



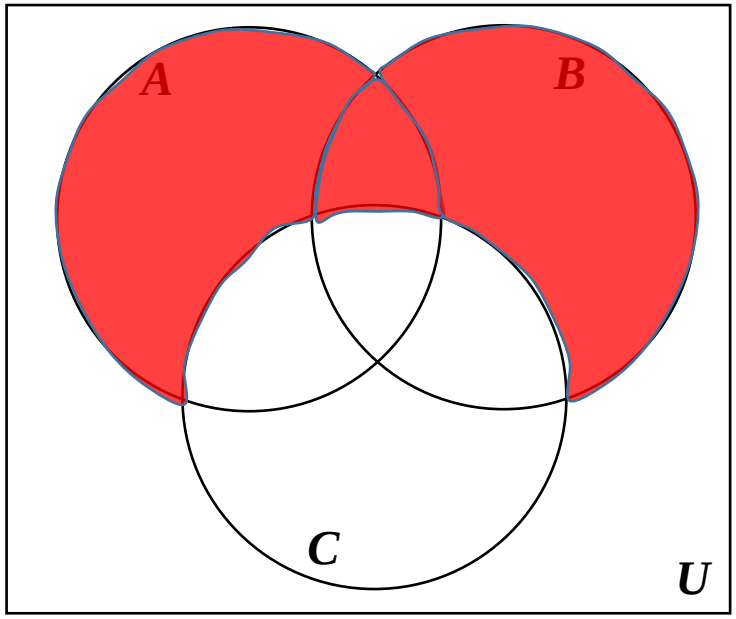
$A \cap B'$

Inside the A circle, but outside the B circle



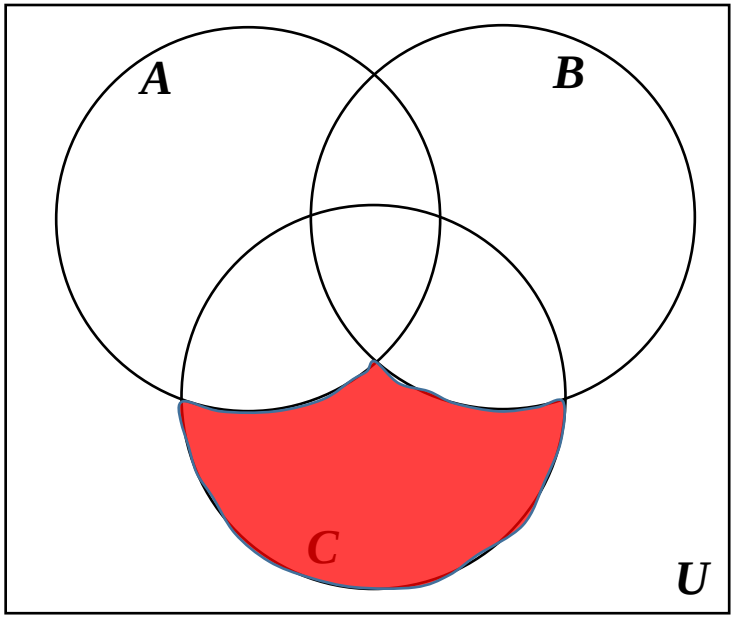
$C \cap B$

Inside the C circle and the B circle



$(A \cup B) \cap C'$

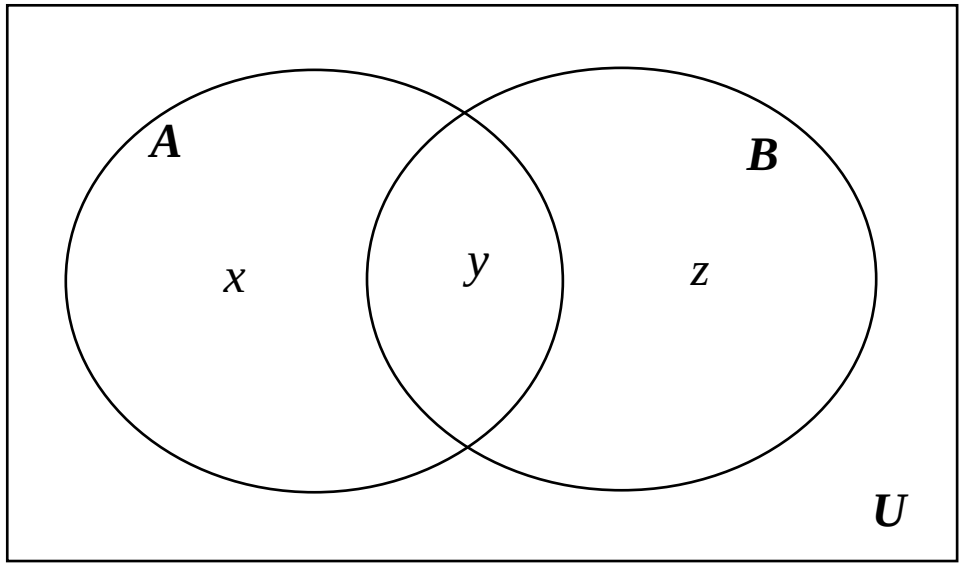
A circle and B circle combined, but excluding C circle



$C \cap (A \cup B)'$

C circle, but excluding the combination of A circle and B circle

Counting Formula for the Union of Two Sets:



$$\begin{aligned} n(A \cup B) &= x + y + z \\ &= (x + y) + (y + z) - y \\ &= n(A) + n(B) - n(A \cap B) \end{aligned}$$

So $n(A \cup B) = n(A) + n(B) - n(A \cap B)$**.**

Examples:

If $n(A)=10$**,** $n(B)=19$**, and** $n(A\cap B)=5$**, then what's** $n(A\cup B)$**?**

$$n(A\cup B)=10+19-5=\boxed{24}$$

If $n(A\cup B)=27$**,** $n(A)=12$**, and** $n(B)=23$**, then what's** $n(A\cap B)$**?**

$$n(A\cap B)=12+23-27=\boxed{8}$$