Unions and Intersections

When you combine all the elements in one set with all the elements in another set, we call this the **union (∪)**. A *union* is like a "marriage" of elements in a set. The symbol for union looks a bit like the letter "u."

A problem involving a union looks like the following.

$\{2, 3, 4, 5\} \cup \{2, 4, 6, 8\}$

This means that you should combine everything in the first set with all new elements from the second set.

$\{2, 3, 4, 5\} \cup \{2, 4, 6, 8\} = \{2, 3, 4, 5, 6, 8\}$

Look at other examples.

Example 1

$\{6, 7, 8, 10\} \cup \{5, 7, 8, 9\} = \{5, 6, 7, 8, 9, 10\}$

Note: You do *not* repeat any element even though it may have been in both sets.

Example 2

$\{\ldots, -3, -2, -1, 0\} \cup \{0, 1, 2, 3, \ldots\} = \{\text{the integers}\}$

This result can be expressed in rule format.

Example 3

$\{5, 7, 9, 11\} \cup \{\ \} = \{5, 7, 9, 11\}$

The *empty set* had nothing to add, so the answer is the same as the first set.

The intersection of two streets is the place where the streets cross each other. The intersection of two lines is also the **point** where they cross, or the *point(s)* they have in common. Likewise, when we take the intersection of two sets, we take only those elements that the two sets have in common. The symbol for **intersection (∩)** looks like an upside-down union symbol.

An *intersection* problem would look like the following.

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

This means that you should include only those elements that the sets have in common.

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

Look at these examples.

Example 1

$\{6, 7, 8, 10\} \cap \{5, 7, 8, 9\} = \{7, 8\}$

Note: The only elements that appears in both sets are 7 and 8.

Example 2

$\{\ldots, -3, -2, -1, 0\} \cap \{0, 1, 2, 3, \ldots\} = \{0\}$

The only element the sets have in common is 0.

Example 3

$\{5, 7, 9, 11\} \cap \{\ \} = \{\ \}$

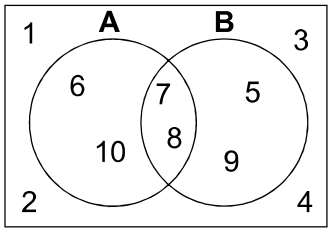
Since the empty set has no elements, it cannot have any elements in common with another set.

We can also use **Venn diagrams** to illustrate the union and intersection of sets. Unit 1 had a *Venn diagram* showing the relationships between sets of numbers.

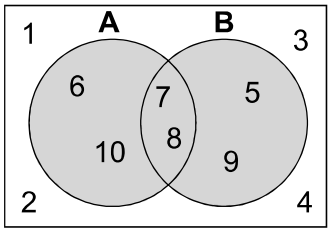
Example 1

Look at the examples below. The sets illustrated are using Venn diagrams.

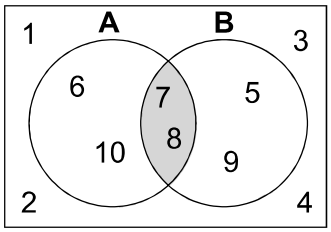
Set A = {6, 7, 8, 10} and set B = {5, 7, 8, 9}



The union of A and B (A $\cup$ B) is both circles. Notice that there are numbers outside of set A and set B. Those are *not* part of the union *or* intersection.



The intersection of A and B (A $\cap$ B) is only the football shape in the middle where the numbers that A and B have in common are located.



Look at these examples as well.

Example 2

$A = \{\ldots, -3, -2, -1, 0\}$, $B = \{0, 1, 2, 3, \ldots\}$

$A \cup B = \{\ldots, -3, -2, -1, 0, 1, 2, 3, \ldots\}$

$A \cap B = \{0\}$

Example 3

$A = \{5, 7, 9, 11\}$, $B = \{\ \}$

$A \cup B = \{5, 7, 9, 11\}$

$A \cap B = \{\ \}$

Your turn to try some.