

In class, we have discussed various types of sets and operations on sets. Now we'll see how we can represent sets pictorially.

Problem 1. Let U be the universal set given by the seven colors of the rainbow. In the space below, write out the set U by listing its elements in braces.

Next, draw a large rectangle with a loop completely inside it. Label the rectangle U and the loop P . Inside the loop P , write all of the colors from the U.S. flag that are listed in U . Outside the loop but inside the rectangle, write down any color in U that is not already in the loop.

What you have done here is drawn a Venn diagram. Venn diagrams describe sets and set relations by using pictures. The rectangle and its contents represent everything in the universal set U , whereas the loop and its contents represent the set P and its elements. In this case, P is the set of primary colors.

Now, using the sets U and P from above, write out the set \bar{P} (the complement of P) in set notation. Where are the elements of \bar{P} found in your Venn diagram?

Problem 2. Now let's look at Venn diagrams containing more than one set. In the space below, draw another rectangle representing a universal set U .

Let $U = \{\text{Kevin, Susan, Jim, Lucy, Ramon, Sarah, Felicia, Jennifer, Greg}\}$, $W = \{\text{woman's names}\}$, and $F = \{\text{names with five letters}\}$. Draw two loops inside the rectangle that represent the two sets W and F , with both loops overlapping each other.

Keep in mind that the loop for W will contain the elements found in W , and similarly for F . Fill in the Venn diagram by placing each element of U in the appropriate region. Which elements are found in the region where the two loops overlap? Explain why these elements are in the overlapping region.

Using set notation, write out the list of elements corresponding to each set:

(a) $W \cap F =$

(b) $W \cup F =$

Write out a sentence that explains the region in the Venn diagram where you can find $W \cap F$. Repeat this for $W \cup F$.

Problem 3. This time, let's say $U = \{\text{dog, cat, beetle, turtle, hamster, elephant}\}$, $A = \{\text{dog, cat, turtle, hamster}\}$, and $B = \{\text{all animals in } U \text{ that have fur}\}$. Draw a Venn diagram with two loops that represent A and B . Place all elements of U in the appropriate region.

Using set notation, write out the list of elements corresponding to each set:

(a) $A \cap B =$

(b) $A \cup B =$

Looking at the elements in each set, can you draw a conclusion about how A and B are related?

Problem 4. Now let's put everything together to get a better handle on Venn diagrams. Let $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$, $E = \{\text{all even numbers between 1 and 11}\}$, $P = \{\text{prime numbers less than 10}\}$, and $T = \{\text{all numbers in } U \text{ that are divisible by 3}\}$.

(a) In the space below, draw a three-loop Venn diagram that illustrates the situation described above.

(b) Using your Venn diagram, list (within braces) the elements of the following sets:

(a) $E \cup P =$

(b) $E \cap P =$

(c) $P \cup T =$

(d) $\bar{P} =$

(e) $\bar{E} =$

(f) $\bar{E} \cap P =$

(g) $P \cap \bar{T} =$

(h) $\bar{T} \cup \bar{P} =$