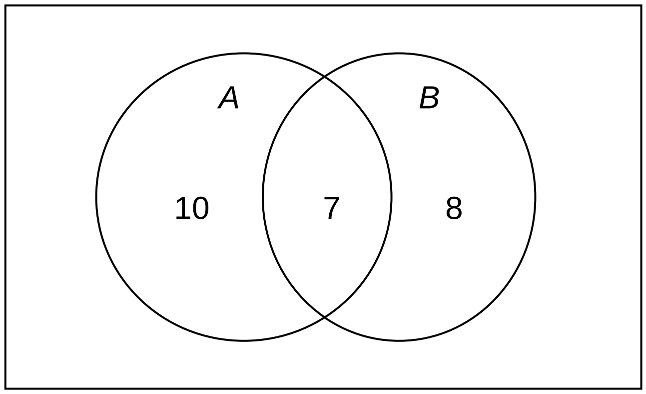
1. Let's investigate the following *Venn diagram* to determine what we will call *the addition property* for sets.



2. Among 80 students, there are 50 taking a mathematics course, 35 taking an English course, and 10 taking both a mathematics course and an English course. How many are taking either a mathematics course or an English course? Count this number two ways: first, with a Venn diagram and second, with the addition property.

3. There are 20,000 students currently attending *Flatland State University*. Through careful surveys, it is determined that 4500 of these students are student athletes. It is also determined that 5200 of these students attending this institution are currently employed. If 8800 students are either student athletes or currently employed, then determine the following by using a Venn diagram representation of the problem situation:

   i) The number of students who are *both* student athletes and currently employed.

   ii) The number of students currently enrolled who are not student athletes.

   iii) The number of student athletes who are not currently employed.

   iv) The number of students who are both not student athletes and not currently employed.

4. I have an unreasonably large collection of 20 cats roaming my property.

8 are talented at performing some trick
8 are adults
9 have a fear of water
3 are both talented and adults
2 are talented and have a fear of water
5 are adults and have a fear of water
2 are talented, adults, and have a fear of water

i) How many of my cats are talented or are adults, but do not have a fear of water?

ii) How many of my cats are talented and are adults, but do not have a fear of water?

iii) How many have no talent, are not adults, and do not have a fear of water?

5. i) Prove pictorially (i.e., with a Venn diagram) the two *DeMorgan's Laws:*

$$\overline{A \cap B} = \overline{A} \cup \overline{B} \text{ and } \overline{A \cup B} = \overline{A} \cap \overline{B}$$

ii) Illustrate this first version of *DeMorgan's Law* with the following universe and sets:

$U = \{a,b,c,d,e,f,g,h\}$

$A = \{a,b,c\}, B = \{b,c,d,e,f\}$

6. Consider some universe U for which the sets A and B are subsets. Under what conditions are each of the following true?

i) $A \cup \varnothing = A$ ii) $A \cup \varnothing = \varnothing$

iii) $A \subset (A \cup B)$ iv) $A \subset (A \cap B)$

v) $n(A \cup B) = n(A) + n(B)$

7. Let $A, B \subseteq U$. Under what conditions is each of the following statements true?

i) $A \cap B = A$ ii) $A \cup B = A$

iii) $\overline{A} \cap B = \varnothing$ iv) $\overline{A \cap B} = U$