

## Section 2.3

### Set Operators

#### Union and Intersection

##### Union of Two Sets

The union of two sets is denoted by  $A \cup B$  is  $A \cup B = \{x \mid x \in A \text{ or } x \in B\}$

##### Intersection of Two Sets

The intersect of two sets is denoted by  $A \cap B$  is  $A \cap B = \{x \mid x \in A \text{ and } x \in B\}$

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#### Example 1

Let  $A = \{1, 2, 3, 4, 5, 6, 7\}$ ,  $B = \{1, 3, 5, 7\}$ ,  $C = \{1, 2\}$ ,  $D = \{3, 4, 5, 6, 7, 8\}$ , and  $E = \phi$

1) Is  $C \subset A$ ?

**Answer: Yes, every element in C is contained in A**

2) Is  $\phi \subset A$ ?

**Yes, the empty set is a subset of any nonempty every set.**

3) Find  $A \cap B$

**Answer:  $A \cap B = \{1, 3, 5, 7\}$**

4) Find  $A \cup B$

**Answer:  $A \cup B = \{1, 2, 3, 4, 5, 6, 7\}$**

5) Find  $A \cap C$

**Answer:  $A \cap C = \{1, 2\}$**

6) Find  $A \cap (B \cap C)$

**Answer:  $A \cap (B \cap C) = \{1, 2, 3, 4, 5, 6, 7\} \cap (\{1, 3, 5, 7\} \cap \{1, 2\}) = \{1, 2, 3, 4, 5, 6, 7\} \cap \{1\} = \{1\}$**

7) Find  $A \cup (B \cap C)$

**Answer:**

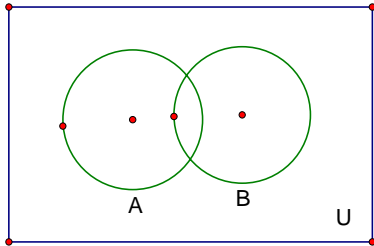
**$A \cup (B \cap C) = \{1, 2, 3, 4, 5, 6, 7\} \cup (\{1, 3, 5, 7\} \cap \{1, 2\}) = \{1, 2, 3, 4, 5, 6, 7\} \cup \{1\} = \{1, 2, 3, 4, 5, 6, 7\}$**

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## Venn Diagrams

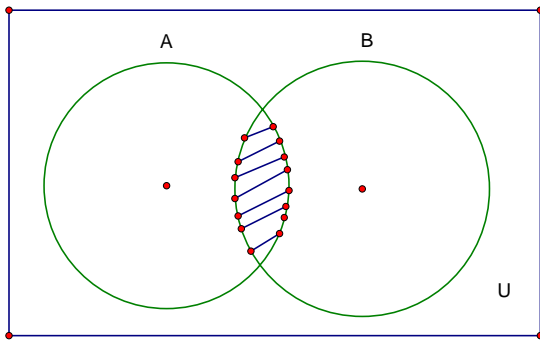
### General Venn diagram for sets A and B



$\mathcal{U}$  = the universal set

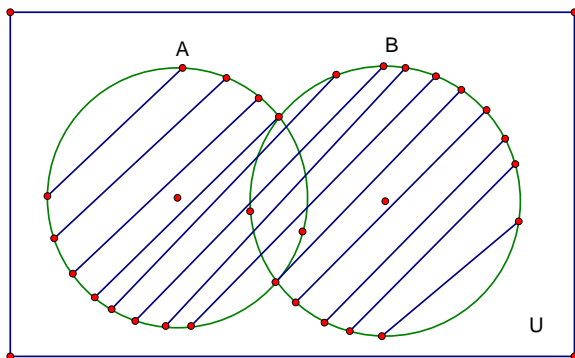
The Venn diagram for  $A \cap B$

$A \cap B$



The Venn diagram for  $A \cup B$

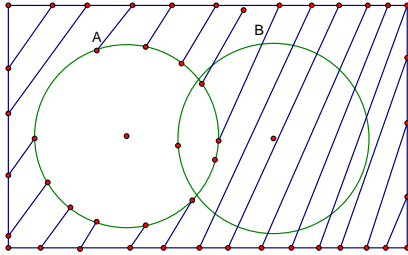
$A \cup B$



## The complement of a set A

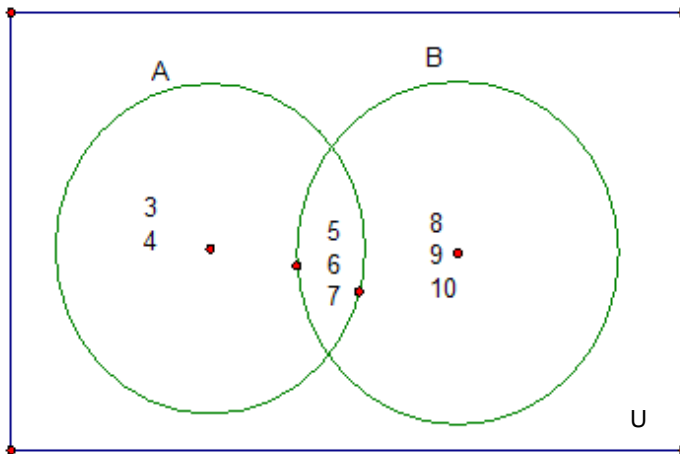
The complement of a set A is the set of all elements in the universal that are not elements of the set A.

$$A' = \{x \mid x \notin A \text{ and } x \in U\}$$



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### Example 2



1) Find  $A \cap B$   
 $A \cap B = \{5, 6, 7\}$

2) Find  $A \cup B$   
 $A \cup B = \{3, 4, 5, 6, 7, 8, 9, 10\}$

3) Find  $A'$   
 $A' = \{8, 9, 10\}$

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### Example 3

Given

$$A = \{1,2,3,4,5,6\}, B = \{4,5,6,7,8\}, U = \{1,2,3,4,5,6,7,8,9,10,11,12\}$$

Find

1)  $A \cup B$

$$A \cup B = \{1,2,3,4,5,6,7,8\}$$

2)  $A \cap B$

$$A \cap B = \{4,5,6\}$$

3)  $A'$

$$A' = \{7,8,9,10,11,12\}$$

4)  $B'$

$$B' = \{1,2,3,9,10,11,12\}$$

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

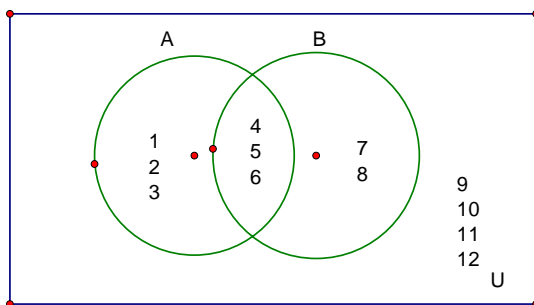
$$(A \cap B)' \cup A = (\{1,2,3,4,5,6\} \cap \{4,5,6,7,8\})' \cup \{1,2,3,4,5,6\}'$$

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

$$= \{1,2,3,7,8,9,10,11,12\} \cup \{7,8,9,10,11\}$$

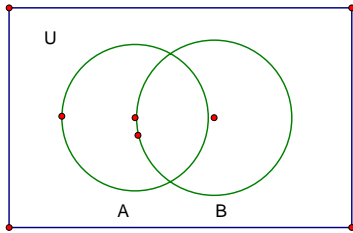
$$= \{1,2,3,7,8,9,10,11,12\}$$

5) Make a Venn diagram of A,B, and U



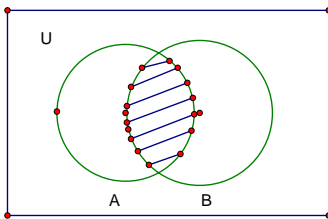
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## Venn diagrams

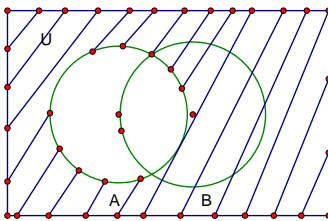


Shade the region corresponding to the indicated set.

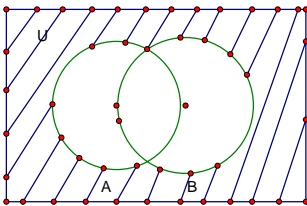
1)  $A \cap B$



2)  $A'$



3)  $A' \cap B'$



4)  $A \cup B'$

