

## Complement of a Set

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# What is a Complement of a Set?

Let set 'A' represents even numbers from 1 to 10. So,  $A = \{2, 4, 6, 8, 10\}$

Now, the [universal set](#)  $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$

As elements 1, 3, 5, 7, 9 are not a part of set 'A', so we call them as the [Complement](#) of 'A'.

From the above example, we can define the complement of the set as follows:

Let 'U' be the universal set and 'A' a subset of 'U'. Then the complement of 'A' is the set of all elements of 'U' which are not the elements of 'A'.

We write complement of 'A' as  $A'$  or  $A^c$ .

Thus,  $A' = \{x: x \in U \text{ and } x \notin A\}$

Also,  $A' = U - A$

We will explore more about the complement of the set by using following example:

Example: Let  $U = \{1, 2, 3, 4, 5, 6\}$ ,  $A = \{2, 3\}$  and  $B = \{3, 4, 5\}$ .

Find  $A'$ ,  $B'$ ,  $A' \cap B'$ ,  $A \cup B$  and hence show that  $(A \cup B)' = A' \cap B'$ .

Solution: We first find  $A'$  and  $B'$

$A' = \{1, 4, 5, 6\}$

$B' = \{1, 2, 6\}$

So,  $A' \cap B' = \{1, 6\}$

Also,  $A \cup B = \{2, 3, 4, 5\}$  so that  $(A \cup B)' = \{1, 6\}$

$(A \cup B)' = \{1, 6\} = A' \cap B'$

From this example, we conclude that if A and B are any two [subsets](#) of the universal set U, then

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

Similarly,  $(A \cap B)' = A' \cup B'$

$U \setminus B'$

From the above discussion, we can state that the complement of [union of two sets](#) is the intersection of their complements and the complement of the [intersection of two sets](#) is the union of their complements.

In general,

$$1) (A \cup B)' = A' \cap B'$$

$$2) (A \cap B)' = A' \cup B'$$

These are called De Morgan's laws.

## Properties of Complement Sets

1) Complement Laws:

$$(i) A \cup A' = U$$

$$(ii) A \cap A' = \emptyset$$

2) [De Morgan's Law](#):

$$(i) (A \cup B)' = A' \cap B'$$

$$(ii) (A \cap B)' = A' \cup B'$$

3) Law of double complementation:

$$(A')' = A$$

4) Laws of empty set and universal set  $\emptyset' = U$  and  $U' = \emptyset$

**Try this:**

If  $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$ ,  $A = \{2, 4, 6, 8\}$  and  $B = \{2, 3, 5, 7\}$ . Verify:

$$(i) (A \cup B)' = A' \cap B'$$

$$(ii) (A \cap B)' = A' \cup B'$$

Now try it yourself! Should you still need any help, [click here](#) to schedule live online session with e Tutor!

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## Reference Links:

- [http://en.wikipedia.org/wiki/Universal\\_set](http://en.wikipedia.org/wiki/Universal_set)

- [http://en.wikipedia.org/wiki/Complement\\_\(set\\_theory\)](http://en.wikipedia.org/wiki/Complement_(set_theory))
- <http://en.wikipedia.org/wiki/Subset>
- [http://en.wikipedia.org/wiki/Union\\_\(set\\_theory\)](http://en.wikipedia.org/wiki/Union_(set_theory))
- [http://en.wikipedia.org/wiki/Intersection\\_\(set\\_theory\)](http://en.wikipedia.org/wiki/Intersection_(set_theory))
- [http://en.wikipedia.org/wiki/De\\_Morgan's\\_laws](http://en.wikipedia.org/wiki/De_Morgan's_laws)

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