The complement of the 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. These are called *De Morgan's laws*. These are named after the mathematician De Morgan.

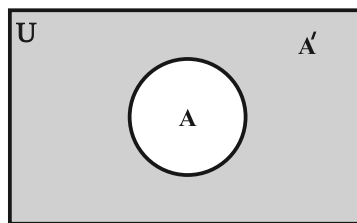The complement A′ of a set A can be represented by a Venn diagram as shown in Fig 1.10.

The shaded portion represents the complement of the set A.

Fig 1.10

Some Properties of Complement Sets

1. Complement laws: (i) $A \cup A' = U$ (ii) $A \cap A' = \phi$

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 $\phi' = U$ and $U' = \phi$.

These laws can be verified by using Venn diagrams.

EXERCISE 1.5

1. Let U = { 1, 2, 3, 4, 5, 6, 7, 8, 9 }, A = { 1, 2, 3, 4}, B = { 2, 4, 6, 8 } and C = { 3, 4, 5, 6 }. Find (i) A′ (ii) B′ (iii) (A ∪ C)′ (iv) (A ∪ B)′ (v) (A′)′ (vi) (B – C)′

2. If U = { *a, b, c, d, e, f, g, h*}, find the complements of the following sets :
    (i) A = {*a, b, c*}   (ii) B = {*d, e, f, g*}
    (iii) C = {*a, c, e, g*}   (iv) D = { *f, g, h, a*}

3. Taking the set of natural numbers as the universal set, write down the complements of the following sets:
    (i)   {*x* : *x* is an even natural number}   (ii) { *x* : *x* is an odd natural number }
    (iii)   {*x* : *x* is a positive multiple of 3}   (iv) { *x* : *x* is a prime number }
    (v)   {*x* : *x* is a natural number divisible by 3 and 5}
    (vi)   { *x* : *x* is a perfect square }   (vii) { *x* : *x* is a perfect cube}
    (viii) { *x* : *x* + 5 = 8 }   (ix) { *x* : 2*x* + 5 = 9}
    (x)   { *x* : *x* ≥ 7 }   (xi) { *x* : *x* ∈ N and 2*x* + 1 > 10 }

4. If U = {1, 2, 3, 4, 5, 6, 7, 8, 9 }, A = {2, 4, 6, 8} and B = { 2, 3, 5, 7}. Verify that
    (i) (A ∪ B)′ = A′ ∩ B′   (ii) (A ∩ B)′ = A′ ∪ B′

5. Draw appropriate Venn diagram for each of the following :
    (i) (A ∪ B)′,   (ii) A′ ∩ B′,   (iii) (A ∩ B)′,   (iv) A′ ∪ B′

6. Let U be the set of all triangles in a plane. If A is the set of all triangles with at least one angle different from 60°, what is A′?