Q Define set.
A collection of well-defined distinct object is called set. It is denoted by capital letters A, B, C etc. For example, $A = \{1,2,3,4\}$

Q: Define union of sets.
The union of two sets A and B, denoted by $A \cup B$ (read as A union B) is the set consisting of all the elements which are either in A or B or in both. Thus

$$A \cup B = \{x | x \in A \text{ or } x \in B \text{ or } x \in A, B \text{ both}\}$$

For example, if $A = \{1,2\}$ and $B = \{1,3\}$, then

$$A \cup B = \{1,2\} \cup \{1,3\}$$
$$A \cup B = \{1,2,3\}$$

Q: Define intersection of two sets. $(\boldsymbol{ALP})$
The intersection of two sets A and B, written as $A \cap B$ (read as A intersection B) is the set consisting of all the common elements of A and B. Thus

$$A \cap B = \{x | x \in A \text{ and } x \in B\}$$

For example, if $A = \{1,2\}$ and $B = \{1,3\}$, then

$$A \cap B = \{1,2\} \cap \{1,3\}$$
$$A \cap B = \{1\}$$

Q: Define difference of sets.
The set difference of A and B denoted by $A - B$ $(or\ A\backslash B)$ is the set of all those elements of A but do not belonging to B. Thus

$$A - B = \{x | x \in A \text{ and } x \notin B\}$$

For example, if $A = \{1,2\}$ and $B = \{1,3\}$, then

$$A - B = \{1,2\} - \{1,3\}$$
$$A - B = \{2\}$$

Q: Define complement of a set.
If U is a universal set and A is a subset of U, then the complement of A is the set of those elements of U, which are not contained in A and is denoted by A' or A^c. Therefore

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

For example, if $U = \{1,2,3,4,5\}$ and $A = \{1,3\}$, then

$$A' = U - A$$
$$A' = \{1,2,3,4,5\} \cup \{1,3\}$$
$$A' = \{2,4,5\}$$

Q: Define a subset and give one example. $(\boldsymbol{ALP})$
A set A is a subset of another set B if all elements of the set A are elements of the set B and it is denoted by $A \subseteq B$. For example if $A = \{1,2\}$ and $B = \{1,2,3\}$, then $A \subseteq B$.

Q: Write DE Morgan law's. $(\boldsymbol{ALP})$
For any two sets A and B DE Morgan law's stated as

- **(i)** $(A \cup B)' = A' \cap B'$
- **(ii)** $(A \cap B)' = A' \cup B'$

Q: Define Venn diagram (closed figures).
British mathematician john Venn (1834-1923) introduced rectangle for a universal set U and its subsets A and B as closed figures inside this rectangle.

Q: Define ordered pair.
An ordered pair of real numbers x and y is a pair (x, y) in which elements are written in specific order.

Q: Define Cartesian product.
Cartesian product of two non-empty sets A and B denoted by $A \times B$ consists of all ordered pairs (x, y) such that $x \in A$ and $y \in B$.
For example, if $A = \{1,2\}$ and $B = \{2,3\}$, then

$$A \times B = \{1,2\} \times \{2,3\}$$
$$A \times B = \{(1,2), (1,3), (2,2), (2,3)\}$$

Q: Define binary relation.
If A and B are any two non-empty sets, then a subset $R \subseteq A \times B$ is called binary relation from set A into set B, because there exist some relationship between first and second element of each order pair in R.

Q: Differentiate between domain and range.
If $f: A \rightarrow B$ is a relation, then
$Domain\ f$ is the set consisting of all first element of each ordered pair in f. $Range\ f$ in the set consisting of all second elements of each ordered pair in f.

Note: if $A = \{1, 2, 3\}$ and $B = \{2, 3\}$, then relation $f: A \rightarrow B$ such that $f = \{(x, y) | x < y\}$

$$A \times B = \{1,2,3\} \times \{2,3\}$$
$$A \times B = \{(1,2), (1,3), (2,2), (2,3), (3,2), (3,3)\}$$

Since $f = \{(x, y) | x < y\}$, so

$$f = \{(1,2), (1,3), (2,3)\}$$
$$Dom\ f = \{1,2\}$$
$$Range\ f = \{2,3\}$$

Q: Define a function. (ALP)
Suppose A and B are two non-empty sets, then relation $f: A \rightarrow B$ is called a function if

(i) $Dom\ f = A$
(ii) Every $x \in A$ appears in one and only one orders pair in f.

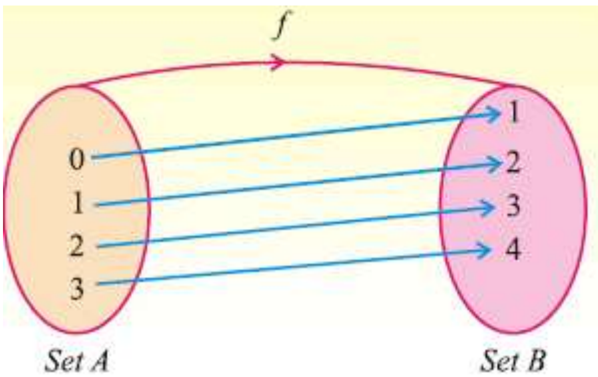
Example: Suppose $A = \{0, 1, 2, 3\}$ and $B = \{1, 2, 3, 4, 5\}$, then a function $f: A \rightarrow B$ such that $f = \{(x, y) | y = x + 1\}$

$$A \times B = \{0,1,2,3\} \times \{1,2,3,4,5\}$$
$$A \times B = \{(0,1), (0,2), (0,3), (0,4), (0,5), (1,1), (1,2), (1,3), (1,4), (1,5), (2,1), (2,2), (2,3), (2,4), (2,5), (3,1), (3,2), (3,3), (3,4), (3,5)\}$$

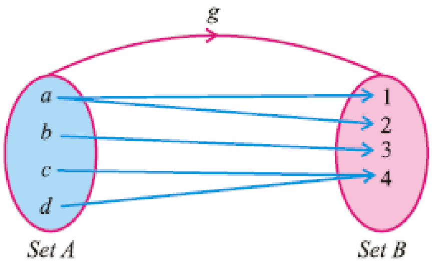
Since $f = \{(x, y) | y = x + 1\}$, so

$$f = \{(0,1), (1,2), (2,3), (3,4)\}$$
$$Dom\ f = \{0,1,2,3\} = A$$
$$Range\ f = \{1,2,3,4\} \subseteq B$$

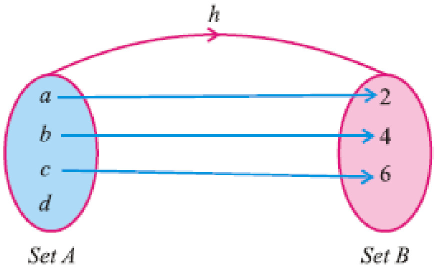
Hence f is a function.



Now let $A = \{a, b, c, d\}$ and $B = \{1,2,3,4\}$ if $g = \{(a, 1), (a, 2), (b, 3), (c, 4), (d, 4)\}$ is a relation, then g is not a function, because an element $a \in A$ has two images in set B.



Also let $A = \{a, b, c, d\}$ and $B = \{2,4,6\}$ if $h = \{(a, 2), (b, 4), (c, 6)\}$ is a relation, then h is not a function because $Dom\ h = \{a, b, c\} \neq A$



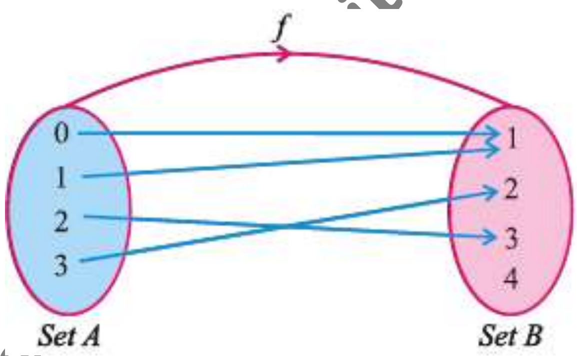
Q: What is meant by domain and co-domain of a function.
If $f: A \to B$ is a function, then A is called the domain of f and B is called co-domain of f.

Q: Define into function. (ALP)
A function $f: A \to B$, is called an into function, if at least one element in B is not an image of some element of set A. That is $Range\ f \subset B$

For example, if $A = \{0,1,2,3\}$ and $B = \{1,2,3,4\}$, let $f = \{(0,1), (1,1), (2,3), (3,2)\}$ is a function

$$Dom\ f = \{0,1,2,3\} = A$$
$$Range\ f = \{1,2,3\} \subset B$$

Hence, f is an into function.

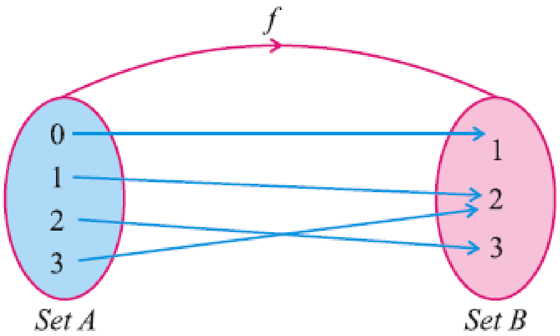


Q: Define an onto (surjective) function. (ALP)
A function $f: A \to B$, is called onto function, if every element of set B is an image of at least one element of set A. That is $Range\ f = B$

For example, if $A = \{0,1,2,3\}$ and $B = \{1,2,3\}$, let $f = \{(0,1), (1,2), (2,3), (3,2)\}$ is a function

$$Dom\ f = \{0,1,2,3\} = A$$
$$Range\ f = \{1,2,3\} = B$$

Hence, f is onto function.

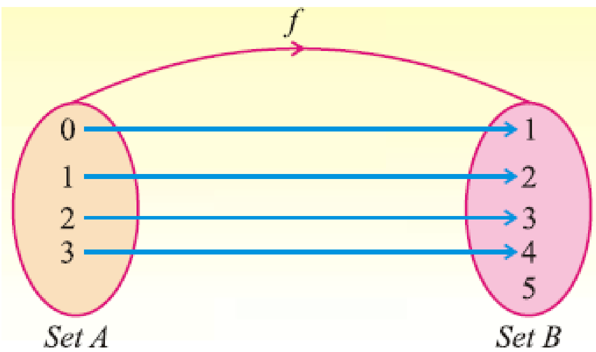


Q: Define one-one function. (ALP)
A function $f: A \to B$, is called one-one function, if all distinct elements of A have distinct images in B. That is $f(x_1) = f(x_2) \Rightarrow x_1 = x_2 \in A$.

For example, if $A = \{0,1,2,3\}$ and $B = \{1,2,3,4,5\}$, let $f = \{(0,1), (1,2), (2,3), (3,4)\}$ is a function

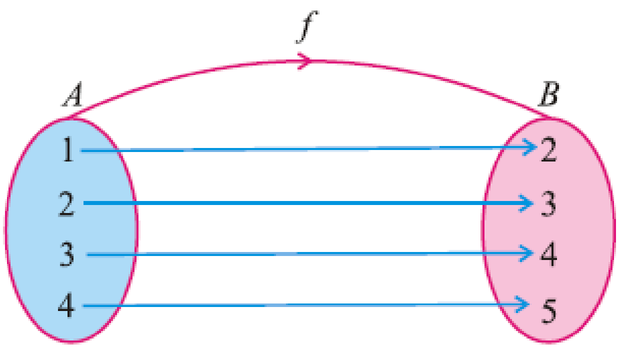
$$Dom\ f = \{0,1,2,3\} = A$$
$$Range\ f = \{1,2,3,4\} \subset B$$

Hence, f is one-one function. It is also into function.



Q: Define bijective function. (ALP)

A function $f: A \to B$, is called bijective function if and only if function f is one-one and onto.



For example, if $A = \{1,2,3,4\}$ and $B = \{2,3,4,5\}$, let $f = \{(1,2),(2,3),(3,4),(4,5)\}$ is a function

$$Dom\ f = \{1,2,3,4\} = A$$
$$Range\ f = \{2,3,4,5\} = B$$

Hence, f is bijective function.

Q: Define into and one-one (injective) function.

A function $f: A \to B$, is called into and one-one function if f is into and one-one function.