UDAY

2026

Relations and Functions

MATHS LECTURE-3

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Topics *to be covered*

- **A** Questions on Relations
- **B** Inverse Relations
- **C** Functions

Domain and Range of a Relation

Domain : The set of first elements of all the ordered pairs present in R is called the domain of relation.

Range : The set of second elements of all the ordered pairs present in R is called range of the relation.

Codomain : The set B is called the codomain of relation R.

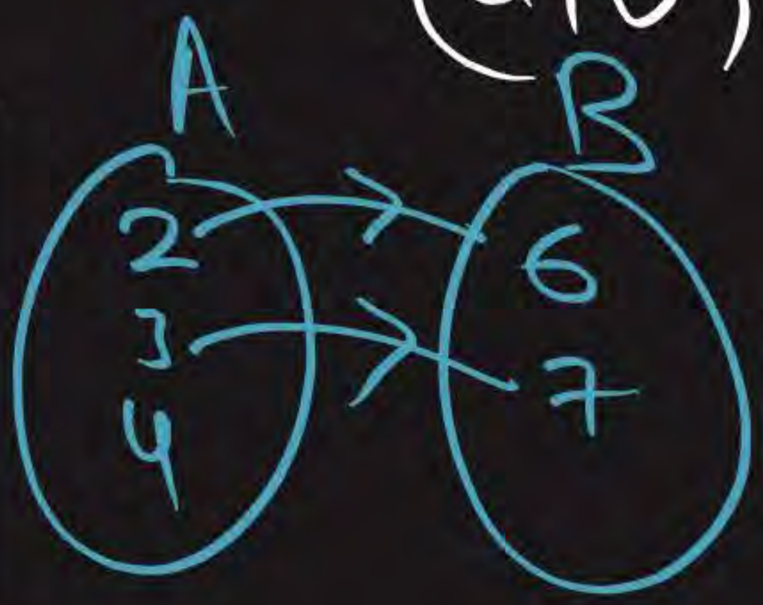
$R : A \to B$

(a, b)

D: $\{2, 3\}$

R: $\{6, 7\}$

C: $\{6, 7\}$



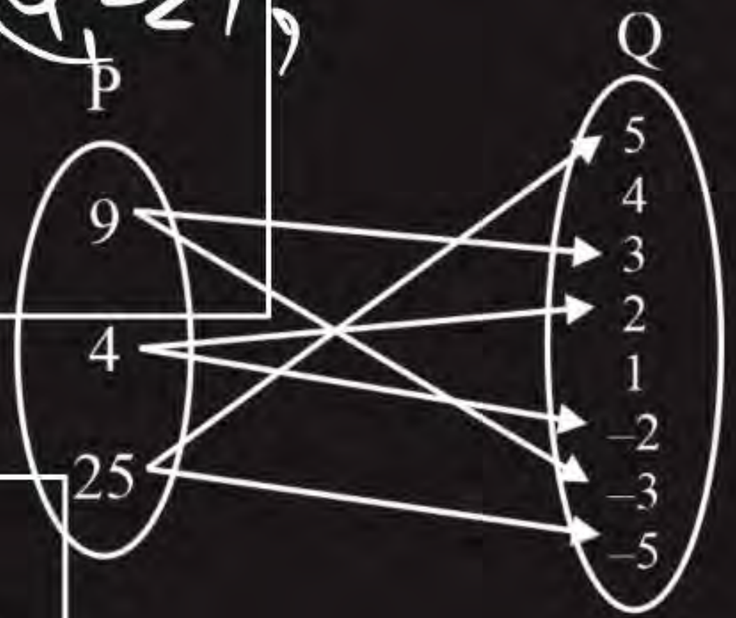
Set of ordered pairs.

#Q. Write the relation between sets P and Q given by an arrow diagram in

(i) Roster form

(ii) Set-builder form

(i) $R = \{(9,3), (9,-3), (4,2), (4,-2), (25,5), (25,-5)\}$



(ii) $R = \{(a,b) : a \in P, b \in Q, b^2 = a\}$

#Q. Determine the domain and range of the relation R defined by:

(i) $R = \{(x, x + 5), x \in \{0, 1, 2, 3, 4, 5\}\}$

$R = \{(0,5),(1,6),(2,7),(3,8),(4,9),(5,10)\}$

$D = \{0,1,2,3,4,5\}$

$R = \{5,6,7,8,9,10\}$

#Q. If $A = \{5, 7\}$, $B = \{9, 13\}$ and $R = \{(a, b) : a \in A, b \in B, a - b \text{ is odd}\}$, then prove that relation R is a empty relation from sets A to B.

$A \times B = \{(5, 9), (5, 13), (7, 9), (7, 13)\}$

$5 - 9 = -4 \rightarrow$ not an odd no.

$5 - 13 = -8 \rightarrow$ not an odd no.

$7 - 9 = -2 \rightarrow$ "

$7 - 13 = -6 \rightarrow$ "

$R = \phi$

#Q. Determine the domain and range of the relation $R = \{(a, b) : a \in N, a < 5, b = 4\}$

$a = 1, 2, 3, 4$

$b = 4$

$R = \{(1,4), (2,4), (3,4), (4,4)\}$

$$\boxed{\begin{aligned} D &= \{1, 2, 3, 4\} \\ R &= \{4\} \end{aligned}}$$

#Q. Let $A = \{1, 2, 3, 4, 5\}$. Define a relation R from A to A by $R = \{(x, y) : y = x - 1, x, y \in A\}$

(i) Depict this relation using an arrow diagram.

(ii) Write down the domain, codomain and range of R.

$R = \{(2,1), (3,2), (4,3), (5,4)\}$

(i)

(ii) $D = \{2, 3, 4, 5\}$

$R = \{1, 2, 3, 4\}$

$C = \{1, 2, 3, 4, 5\}$

Inverse of a Relation

Inverse Relation:

Let A, B be two sets and let R be a relation from a set A to a set B. Then, the inverse of R, denoted by R^{-1}, is a relation form B to A and is defined by $R^{-1} = \{(b, a) : (a, b) \in R\}$.

$R = \{(1,2), (2,3), (3,4), (4,5)\}$

$R^{-1} = \{(2,1), (3,2), (4,3), (5,4)\}$

R inverse

Domain of $R = \{1,2,3,4\}$

Range of $R = \{2,3,4,5\}$

Domain of $R^{-1} = \{2,3,4,5\}$

Range of $R^{-1} = \{1,2,3,4\}$

$\boxed{D \text{ of } R = R \text{ of } R^{-1}}$ $\boxed{R \text{ of } R = D \text{ of } R^{-1}}$

#Q. Let A be the set of first ten natural number and let R be a relation on A defined by $(x, y) \in R \Leftrightarrow x + 2y = 10$, i.e., $R = \{(x, y) : x \in A, y \in A \text{ and } x + 2y = 10\}$. Express R and R^{-1} as sets of ordered pairs. Also, determine:

#Copy

(i) Domain of R and R^{-1}.

(ii) Range of R and R^{-1}.

$R = \{(2,4), (4,3), (6,2), (8,1)\}$

$R' = \{(4,2), (3,4), (2,6), (1,8)\}$

#Q. A relation R is defined on the set Z of integers as $(x, y) \in R \Leftrightarrow x^2 + y^2 = 25$.

Roster form:-

$R = \{(0,5), (0,-5), (3,4), (3,-4),$
$(5,0), (-5,0), (4,3), (4,-3)$
$(-3,4), (-3,-4), (-4,3), (-4,-3)\}$

$y^2 = 25 - x^2$

$\boxed{y = \pm\sqrt{25 - x^2}}$

$x = 0$

$y = 5, -5$

#QT

Rational no.

#Q. Let R be a relation on Q defined by $R = \{(a, b) : a, b \in Q \text{ and } a - b \in Z\}$.

Show that :

for all $= \forall$

(i) $(a, a) \in R$ for all $a \in Q$

(ii) $(a, b) \in R \Rightarrow (b, a) \in R$

(iii) $(a, b) \in R, (b, c) \in R \Rightarrow (a, c) \in R$

(i) $(a, a) \in R, \forall a \in Q$

$\because a - a = 0$

$0 \in Z$.

(ii) $(a, b) \in R, \forall a, b \in Q$

$\therefore a - b \in Z$

$\Rightarrow -(a-b) \in Z$

$\Rightarrow -a + b \in Z$

$\Rightarrow b - a \in Z$

$\Rightarrow \boxed{(b, a) \in R}$

#QT

#Q. Let R be a relation on Q defined by $R = \{(a, b) : a, b \in Q \text{ and } a - b \in Z\}$.

Show that :

(i) $(a, a) \in R$ for all $a \in Q$

(ii) $(a, b) \in R \Rightarrow (b, a) \in R$

(iii) $(a, b) \in R, (b, c) \in R \Rightarrow (a, c) \in R$

(iii) $(a,b) \in R$

$\Rightarrow \boxed{a-b \in Z}$ (1)

$(b,c) \in R$

$\boxed{b-c \in Z}$ (2)

(1) + (2)

$(a-\cancel{b}) + (\cancel{b}-c) \in Z$

$a-c \in Z$

$\Rightarrow \boxed{(a,c) \in R}$

#Q. Let R be a relation on N defined by $R = \{(a, b) : a, b \in N \text{ and } a = b^2\}$.

Check :

(i) $(a, a) \in R$ for all $a \in N$

(ii) $(a, b) \in R \Rightarrow (b, a) \in R$

(iii) $(a, b) \in R, (b, c) \in R \Rightarrow (a, c) \in R$

Justify your answer in each case.

(i) False.

$\because (2,2) \notin R$.

(ii) False.

as, $(81, 9) \in R$

but, $(9, 81) \notin R$.

(iii) False.

$(16, 4) \in R$ and $(4, 2) \in R$

but $(16, 2) \notin R$.

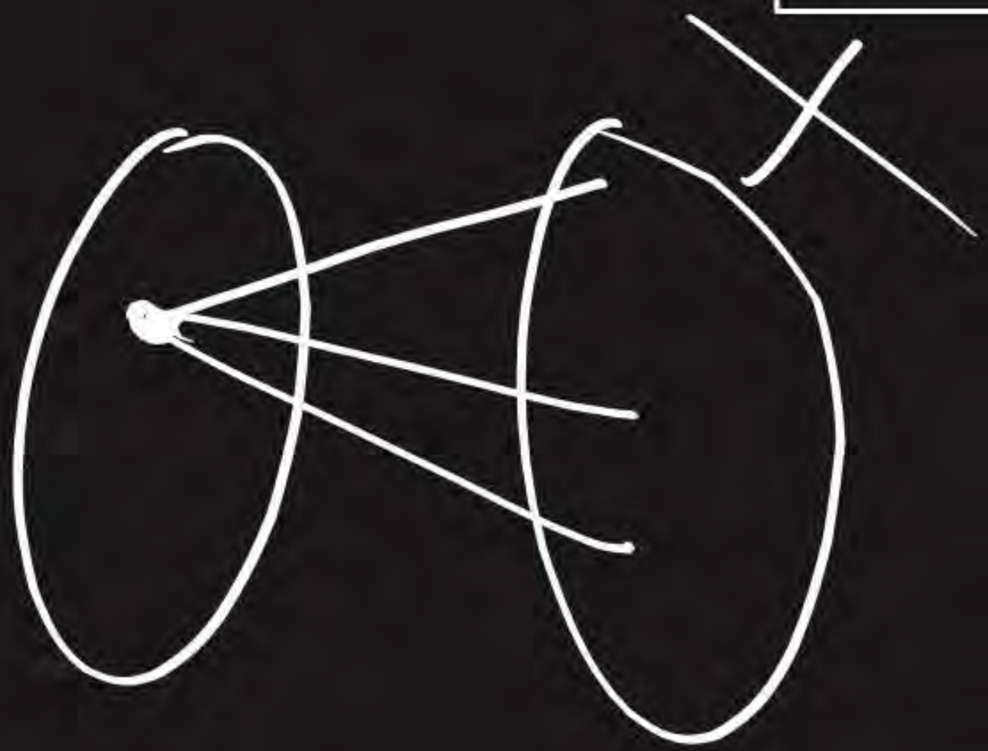
What is a function

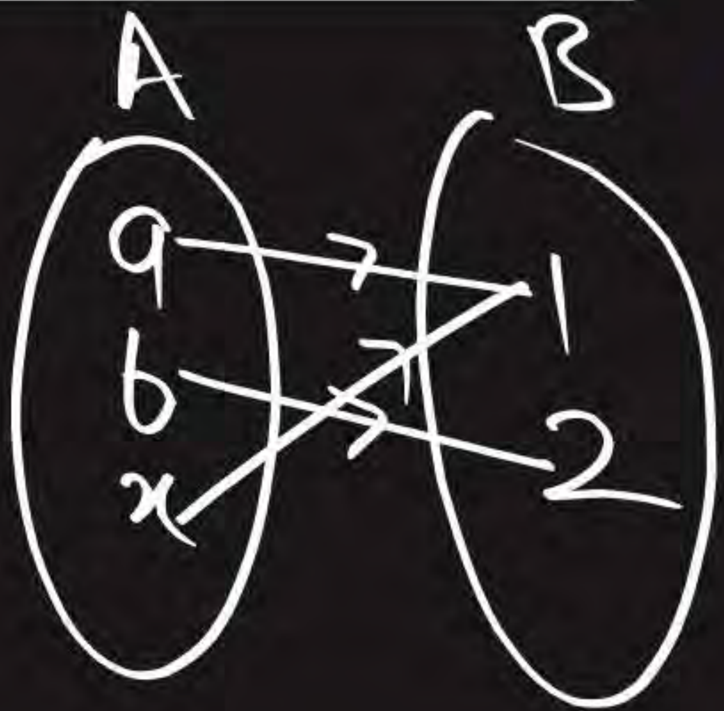
Special Relation

A relation R from a set A to set B is called a function

(i) Every element of set A has an image in set B.

(ii) No element of set A has more than one image in set B.





Function

NOTE

(i) Converging rays are allowed but diverging rays are not allowed.

(ii) Complete set A must be domain.

Function

Example:

(i) $\boxed{\text{Let } A = \{2, 3, 4\}}$, $\boxed{B = \{3, 4, 5\}}$ and $\boxed{f_1, f_2 \text{ and } f_3}$ be three subsets of $A \times B$ defined as

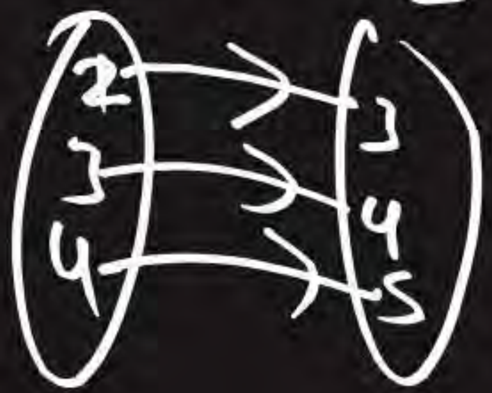
Subsets

$$f_1 = \{(2, 3), (3, 4), (4, 5)\}$$

$$f_2 = \{(2, 3), (2, 4), (3, 4), (4, 5)\}$$

and $$f_3 = \{(2, 4), (3, 5)\}$$

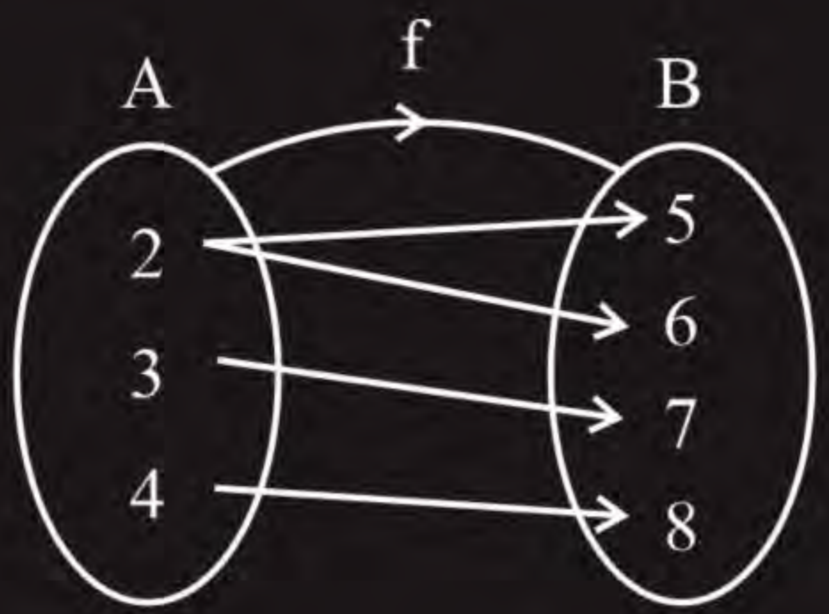
$A \xrightarrow{f_1} B$



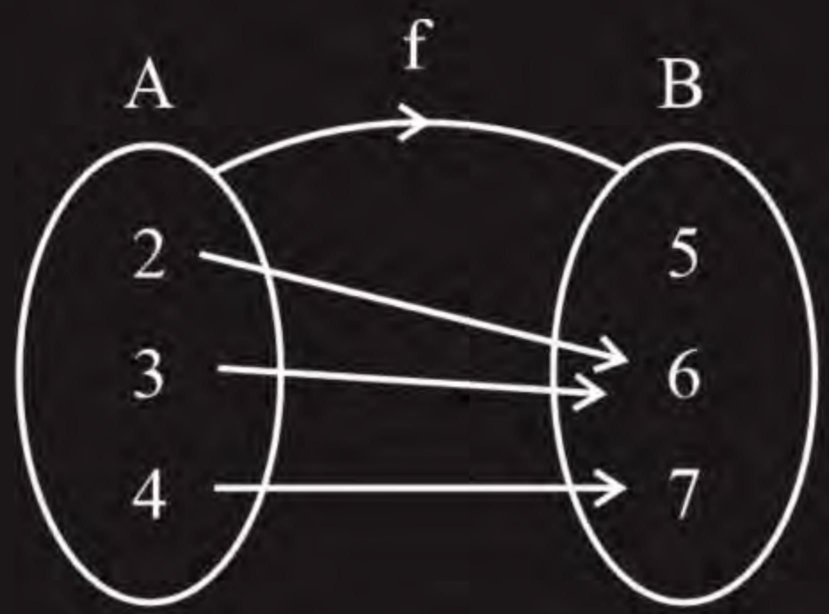
Function

Example:

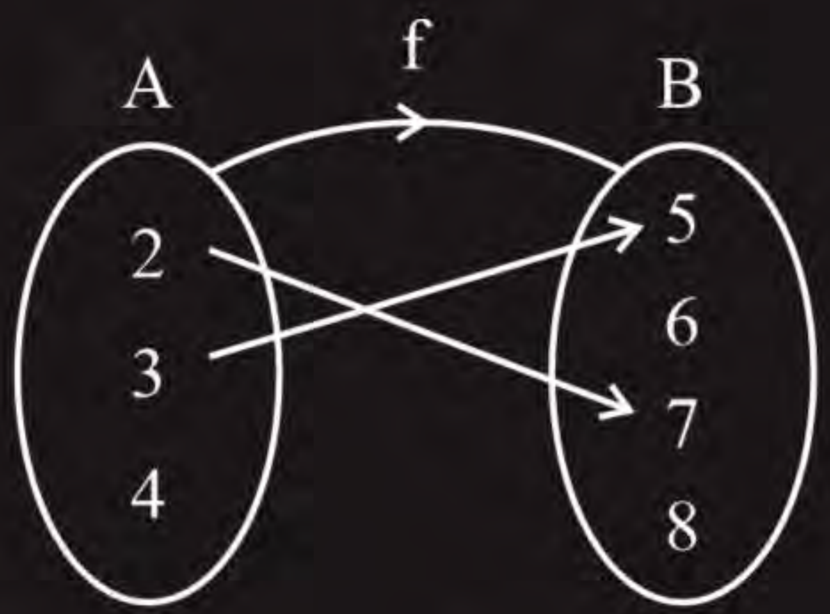
(ii) In the form of arrow diagram,



(a) f is not a function



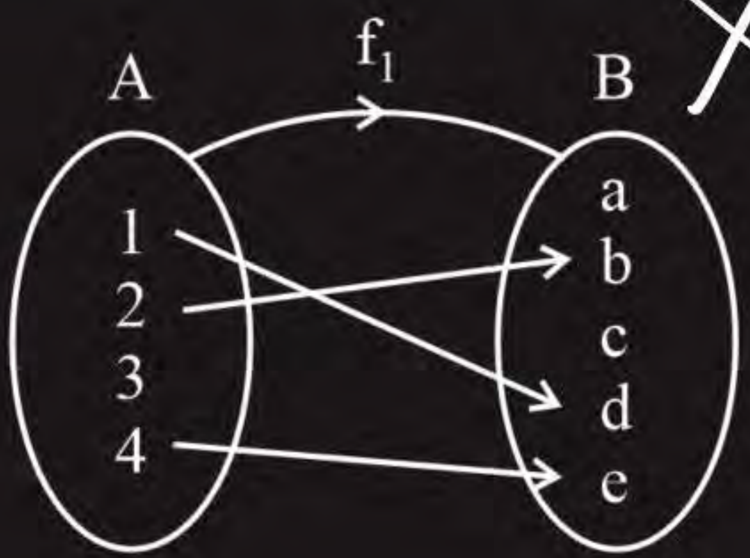
(b) f is a function



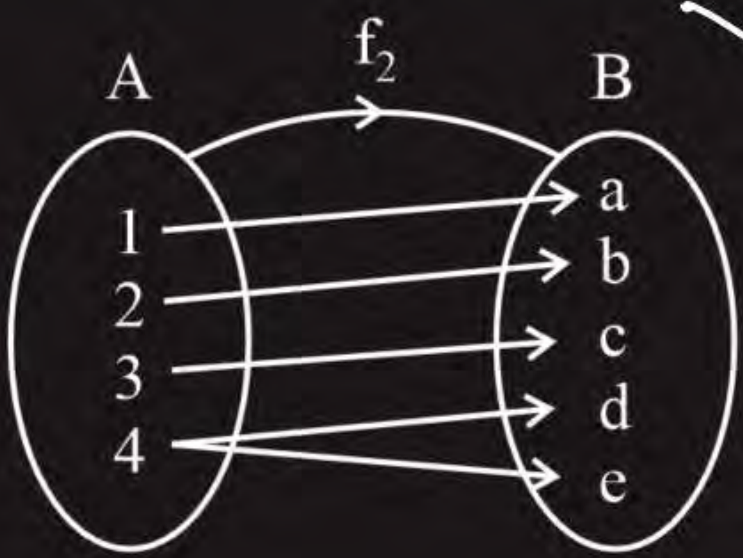
(c) f is not a function

#Q. Let A = {1, 2, 3, 4} and B = {a, b, c, d, e} be two set and let f_1, f_2, f_3, and f_4 be rules associating elements of set A to elements of set AB as shown in fig 1 to fig 4.

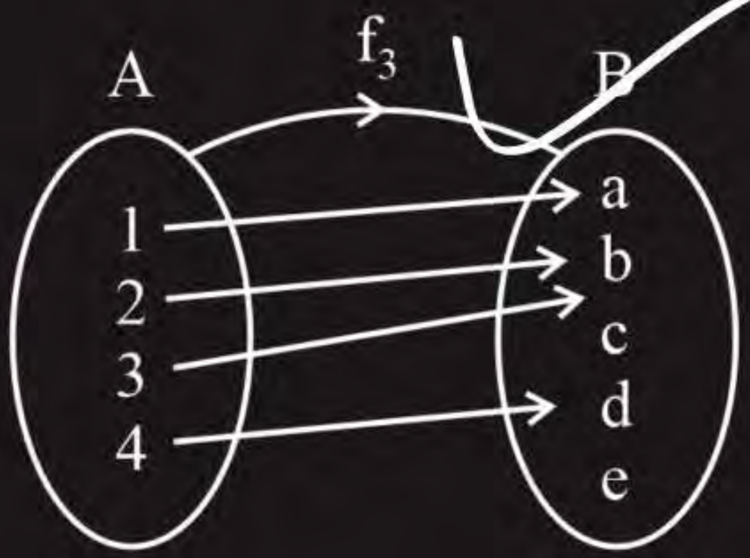
A



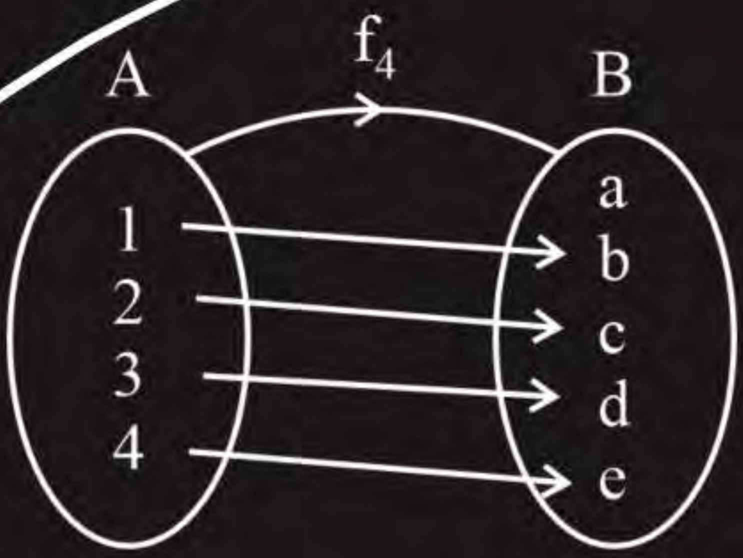
B



C



D



Functions

#GPU

A special type of relation is called function.

Function as a Relation

A relation f from a non-empty set A to a non-empty set B is said to be a function, if every element of set A has one and only one image in set B.

If f is a function from set A to set B, then we write

$f : A \to B$ or $A \xrightarrow{f} B$

and it is read as f is a function from A to B or f maps A to B.

If $(a, b) \in f$, then we can also write it as $f(a) = b$.

Here, b is called the image of a under f and a is called the pre-image of b under f.


WORK HARD
DREAM BIG
NEVER GIVE UP

RITIK SIR
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Thank You