Relations & Functions- L1 : Relation

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From Apr 8th - Apr 30th @12 PM

Apr 8th Strategy Class 11th Math

Apr 9th Sequences & Series-L1: Arithmetic Progression

Apr 10th Sequences & Series-L2: Geometric Progression

Apr 11th Sequences & Series-L3: AM GM HM

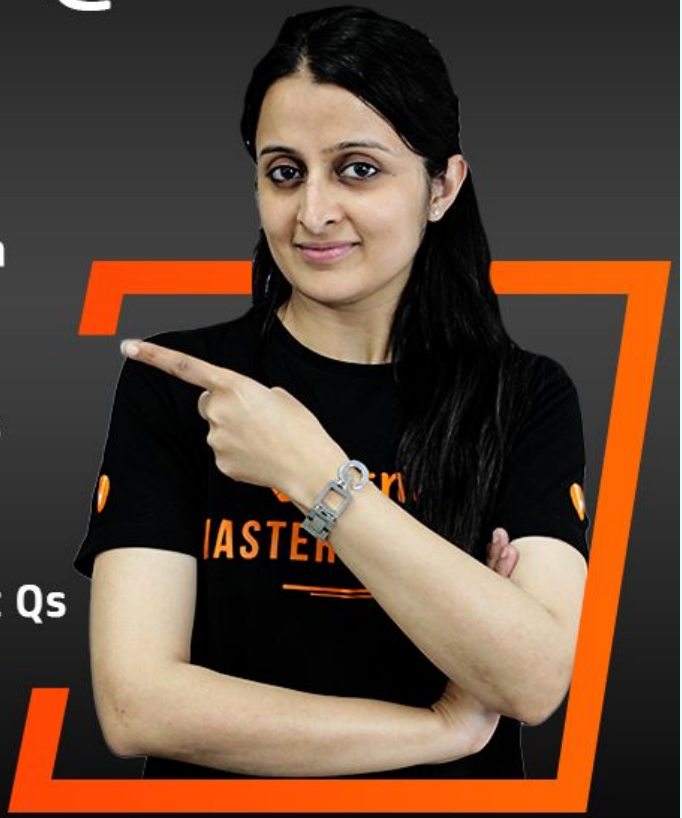
Apr 13th Sequences & Series-L4: AGP and Sum of Series

Apr 14th Sequences & Series-L5: Method of Difference

Apr 15th Sequences & Series-L6: NCERT Most Important Qs

Apr 16th Sets - L1 : Basics & Algebra of Sets- 1

Apr 17th Sets - L2 : Basics & Algebra of Sets- 2



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From Apr 9th - Apr 30th @12 PM

Apr 20th Relations & Functions- L1 : Relation

Apr 21st Relations & Functions- L2 : Basic of Function

Apr 22nd Relations & Functions- L3 : Types of Functions

Apr 23rd Relations & Functions- L4 : Domain & Range of a Function

Apr 24th Relations & Functions- L5 : Inverse of a Function

Apr 25th Relations & Functions- L6 : Greatest Integer & Modulus Functions

Apr 27th Complex Numbers - L1 : Basics of Complex Number

Apr 28th Complex Numbers - L2 : Algebra of Complex Numbers

Apr 29th Complex Numbers - L3 : The Modulus and the Conjugate of a Complex Number

Apr 30th Complex Numbers - L4 : Argand Plane and Polar Representation

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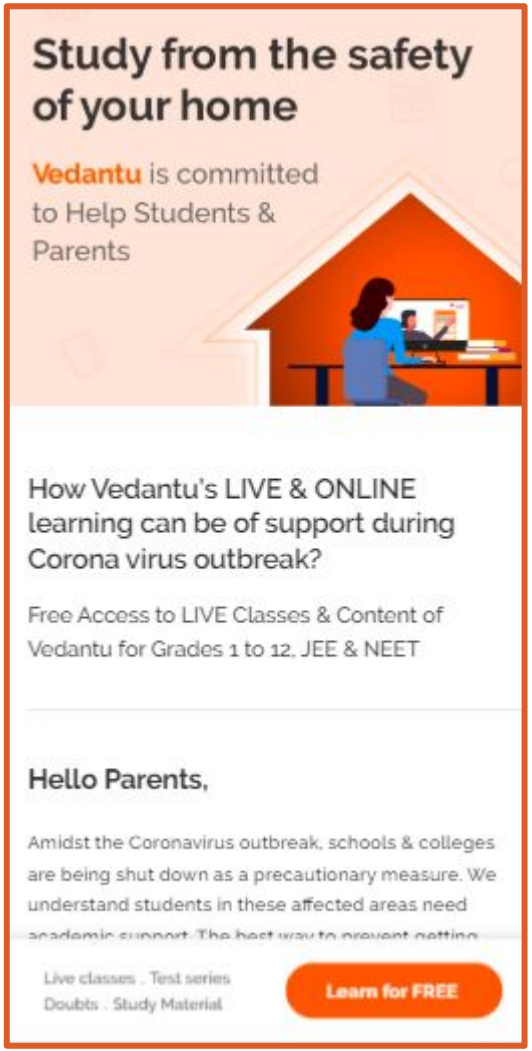

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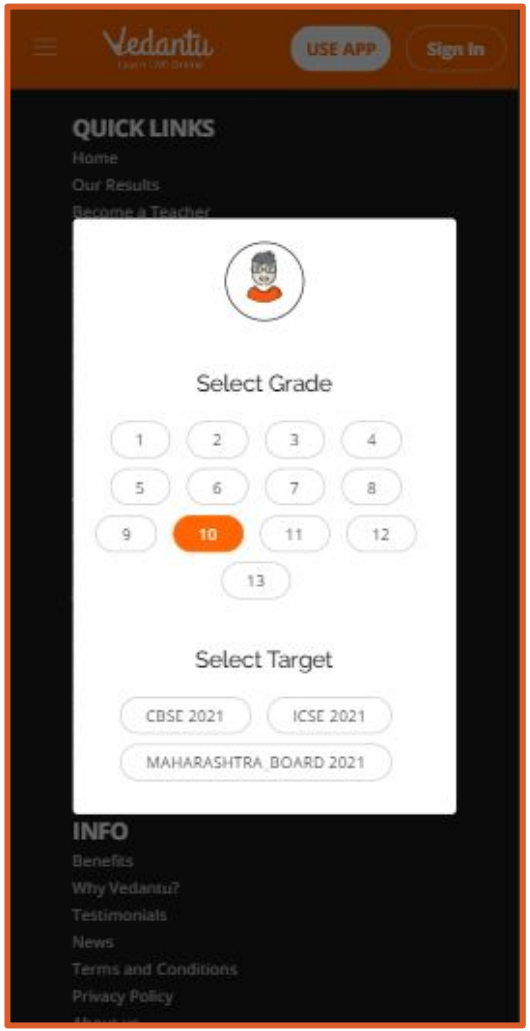

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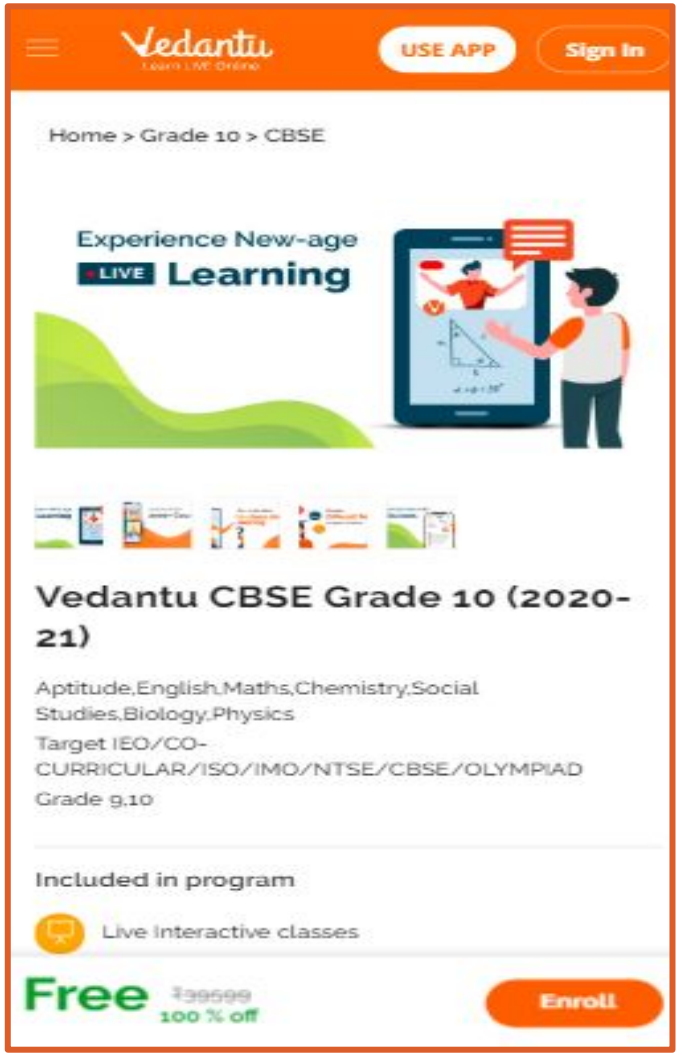

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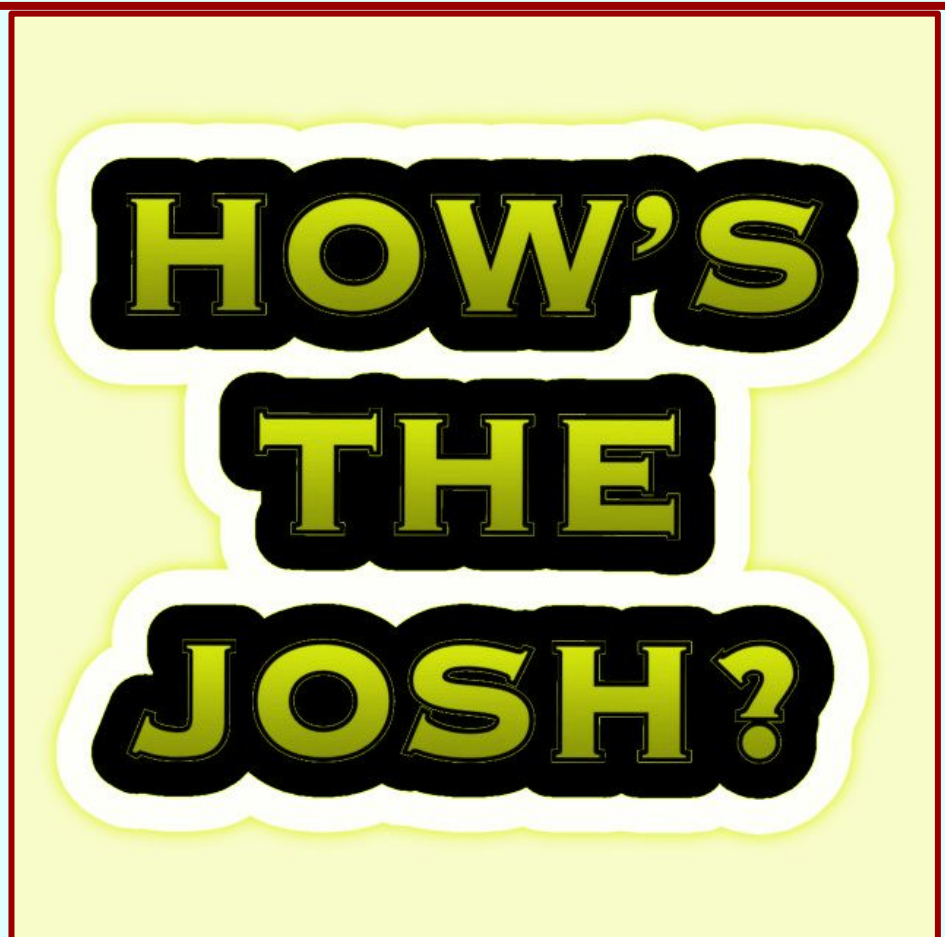
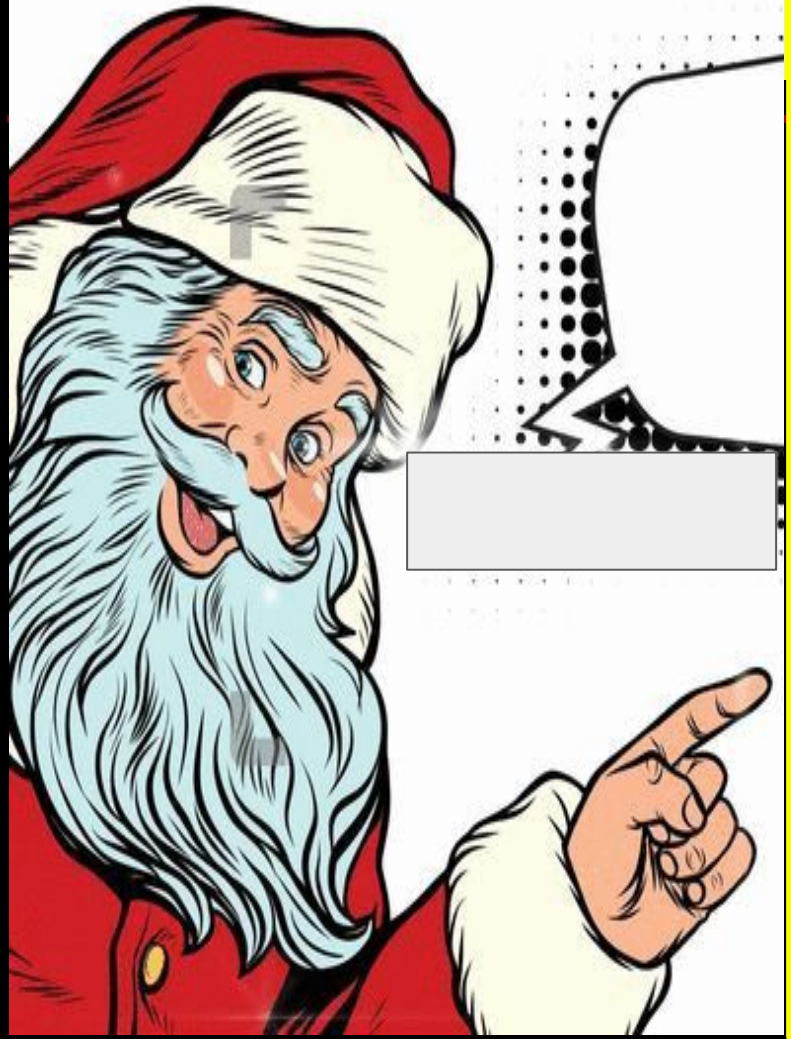
Relations & Functions - Lesson 1





{things to do}

- Cartesian Product
- Relation
- No. of Relations

- Domain
- Range

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CARTESIAN PRODUCT

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Ordered Pair

If a is an arbitrary element from set A and b is an arbitrary element from set B then, the pair (a, b) is called an **ordered pair**

Note : $(a, b) \neq (b, a)$ Unless $a = b$

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Cartesian product

The Cartesian product of two sets A, B is the set of all possible ordered pairs (a, b) such that $a \in A$ and $b \in B$

The Cartesian product for A and B is represented with "$A \times B$"

$A \times B = \{ (a, b) : a \in A, b \in B\}$

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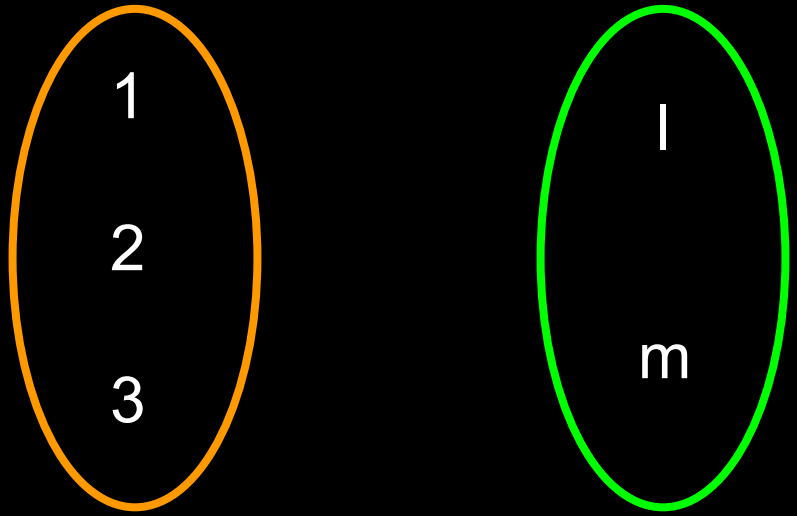
$A = \{1, 2, 3\}$ $B = \{l, m\}$

$A \times B =$



Note : $n(A \times B) = n(A) \times n(B) = n(B \times A)$

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Question

If $A = \{1, 2, 3\}$, find $A \times A$

Relations & Functions - Lesson 1

Question

If $A = \{1, 2, 3\}$, find $A \times A$

Solution

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

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

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Question

If $A = \{2, 5\}$ $B = \{3, 4, 7\}$ $C = \{3, 4, 8\}$

Prove (i) $A \times (B \cup C) = (A \times B) \cup (A \times C)$

(ii) $(A - B) \times C = (A \times C) - (B \times C)$

Relations & Functions - Lesson 1

Question

If $A = \{2, 5\}$ $B = \{3, 4, 7\}$ $C = \{3, 4, 8\}$

Prove (i) $A \times (B \cup C) = (A \times B) \cup (A \times C)$

(ii) $(A - B) \times C = (A \times C) - (B \times C)$

Solution

$(B \cup C) = \{3, 4, 7, 8\}$

$A \times (B \cup C) = \{(2, 3), (2, 4), (2, 7), (2, 8),$

$(5, 3), (5, 4), (5, 7) (5, 8)\}$

Relations & Functions - Lesson 1

Question

If A = {2, 5} B = {3, 4, 7} C = {3, 4, 8}

Prove (i) $A \times (B \cup C) = (A \times B) \cup (A \times C)$

(ii) $(A - B) \times C = (A \times C) - (B \times C)$

Solution

$A \times B = \{(2, 3), (2, 4), (2, 7), (5, 3), (5, 4), (5, 7)\}$

$A \times (B \cup C) = \{(2, 3), (2, 4), (2, 7), (2, 8),$

$A \times C = \{(2, 3), (2, 4), (2, 8), (5, 3), (5, 4), (5, 8)\}$

$(5, 3), (5, 4), (5, 7) (5, 8)\}$

$(A \times B) \cup (A \times C) = \{(2, 3), (2, 4), (2, 7), (2, 8),$

$(5, 3), (5, 4), (5, 7), (5, 8)\}$

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RELATION

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Pointing to a photograph of a boy Suresh said,

"He is the son of the only son of my mother."

How is Suresh related to that boy?

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Let's understand this concept with an example

Real Life examples : (Teacher, Student), (Husband, Wife), (Mother, Son), (Brother, Sister)

Math examples : (a ⊥ b), (9 > 2), (line p ll line q).

NOTE : Relation is always in pairs

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Relation

A, B are two sets, any Relation R from A to B is a subset of A × B. If $(x, y) \in R$, we say that "x is R - related to y" and represent it with "x R y".

$\therefore$ **$R = \{(x, y) : x \in A, y \in B, x\ R$**

For example

if A = {1, 2, 3} and B = {1, 8 , 27}

A × B = {(1, 1), (1, 8), (1, 27), (2, 1), (2, 8),
(2, 27) (3, 1), (3, 8), (3, 27)}

Relationship is cube.

R =

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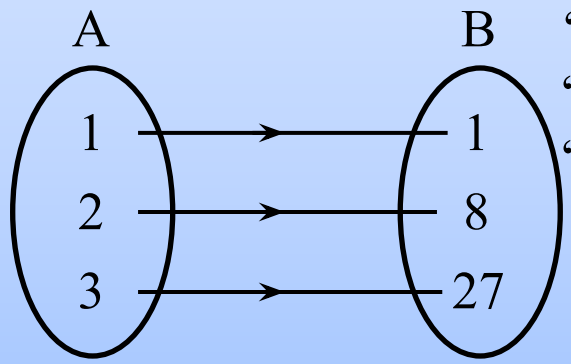
Venn representation of relation

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

$B = \{1, 8, 27\}$

$R = \{(1, 1), (2, 8) (3, 27)\}$

$R : A \rightarrow B$ (To be read as **R : A mapping B**)



'1 is mapped to 1'

'8 is image of 2'

'3 is pre-image of 27'

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Question

A = { 2, 4, 6} B = {1, 5} A relation R : A → B is defined as

R = {(x, y) : x ∈ A, y ∈ B and x >

Relations & Functions - Lesson 1

Question

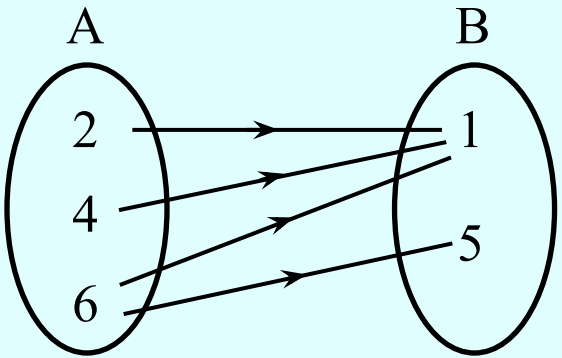
A = { 2, 4, 6} B = {1, 5} A relation R : A → B is defined as R = {$(x, y) : x \in A, y \in B$ and $x > y$}

Solution

A = { 2, 4, 6} B = { 1, 5}

A × B = {(2, 1), (2, 5), (4, 1), (4, 5), (6, 1), (6, 5)}

R = {(2, 1), (4, 1), (6, 1), (6, 5)}



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DOMAIN AND RANGE OF A RELATION

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Domain of a relation

If R is the relation from A to B i.e $R \subseteq A \times B$, then the set of all first elements in ordered pairs in R is called Domain of R

Domain of R = $\{x : (x, y) \in R\}$

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Range of a relation

If R is the relation from A to B i.e $R \subseteq A \times B$, then the set of all second elements in ordered pairs in R is called Range of R

Range of R = $\{y : (x, y) \in R\}$

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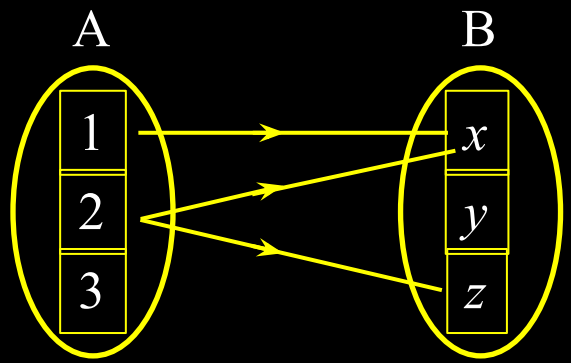
$R : A \rightarrow B$



Note

Domain $\subseteq$ A

Range $\subseteq$ B

Domain of R =

Range of R =

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Question

Find domain and range of relation

$R = \{(x, y) : x, y \in N, y = x^2 + 3, 0 < x < 5\}$

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Relations & Functions - Lesson 1

Question

Find domain and range of relation

$R = \{(x, y) : x, y \in N, y = x^2 + 3, 0 < x < 5\}$

Solution

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

$R = \{(1, 4), (2, 7), (3, 12), (4,19)\}$

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

Range of $R = \{4, 7, 12, 19\}$

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Question

If a relation R is defined on set of Natural numbers,
$R = \{(x, y): x \in N, y \in N, 5x + y = 41\}$. Find range of R

Relations & Functions - Lesson 1

Question

If a relation R is defined on set of Natural numbers,
$R = \{(x, y): x \in N, y \in N, 5x + y = 41\}$. Find range of R

Solution

$y = 41 - 5x$

If $x = 1 \Rightarrow y = 36$

If $x = 2 \Rightarrow y = 31$

If $x = 3 \Rightarrow y = 26$

If $x = 4 \Rightarrow y = 21$

If $x = 5 \Rightarrow y = 16$

If $x = 6 \Rightarrow y = 11$

If $x = 7 \Rightarrow y = 6$

If $x = 8 \Rightarrow y = 1$

If $x = 9 \Rightarrow y \notin N$

$\Rightarrow$ Range $\{1, 6, 11, 16, 21, 26, 31, 36\}$

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Number of Relations

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Number of Relations

If n (A) = p , n (B) = q , then number of relations from A to B = 2^{pq}

Proof

Every relation R : A→B is subset of A × B

No. of relations possible = number of subsets of A × B

n (A × B) = n (A) × n (B)

= pq

Number of relations = 2^{pq}

INVERSE OF A RELATION

Relations & Functions - Lesson 1

Inverse of Relation

If a relation R is from set A to set B, then inverse of relation R is

$R^{-1} = \{(y, x) : \forall\ (x, y) \subset R\}$

For example

If R = {(2,4),(3,9),(4,16)} then,

R^{-1} = {(4,2),(9,3),(16,4)}

Relations & Functions - Lesson 1

Question

A relation $R : N \rightarrow N$ is defined as $R = \{(x, y), x \in N, y \in N \ \& \ y = 35 - x^3\}$. Find domain and range of R^{-1}

Relations & Functions - Lesson 1

Question

A relation $R : N \rightarrow N$ is defined as $R = \{(x, y), x \in N, y \in N$ &
$y = 35 - x^3\}$. Find domain and range of R^{-1}

Solution

$y = 35 - x^3$

$x = 1 \Rightarrow y = 34$

$x = 2 \Rightarrow y = 27$

$x = 3 \Rightarrow y = 8$

$x = 4 \Rightarrow y \notin N$

$\therefore R = \{(1,34)(2,27),(3,8)\}$

$\therefore R^{-1} = \{(34,1)(27,2),(8,3)\}$

Domain of $R^{-1} = \{34,27, 8\}$

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

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Q. Two sets A and B are as under :

$A = \{(a, b) \in R \times R : |a - 5| < 1 \text{ and } |b - 5| < 1\}$;

$B = \{(a, b) \in R \times R : 4(a - 6)^2 + 9(b - 5)^2 \leq 36\}$. Then :

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A neither $A \subset B$ nor $B \subset A$

B $B \subset A$

C $A \subset B$

D $A \cap B = 4\phi$ (an empty set)

Relations & Functions - Lesson 1

Q. Two sets A and B are as under :

$A = \{(a, b) \in R \times R : |a - 5| < 1 \text{ and } |b - 5| < 1\}$;

$B = \{(a, b) \in R \times R : 4(a - 6)^2 + 9(b - 5)^2 \le 36\}$. Then :

JEE (Main) 2018

A neither $A \subset B$ nor $B \subset A$

B $B \subset A$

C $A \subset B$

D $A \cap B = 4\phi$ (an empty set)

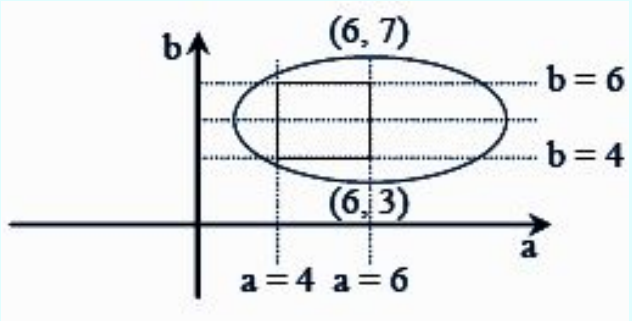
Solution:

$$A = \{(a, b) : a \in (4, 6),\ b\,(4, 6)\}$$

$$B = \left\{(a, b) : 4(a - 6)^2 + 9(b - 5)^2 \le 36\right\}$$

$$\Rightarrow \frac{(a-6)^2}{9} + \frac{(b-5)^2}{4} \le 1$$

$$\Rightarrow A \subset B$$



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Q. Let A = {1,2,3,4,6} and R be the relation on A defined by {(a,b) : a,b ϵ A,b is exact divisible by a }

1) Write R is roster form
2) Find the domain of R
3) Find the range of R

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Solution:

$A = \{1, 2, 3, 4, 6\}$

$R = \{(a, b) : a, b \in A, b \text{ is exactly divisible by a}\}$

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

(ii) Domain of $R = \{1, 2, 3, 4, 6\}$

(iii) Range of $R = \{1, 2, 3, 4, 6\}$

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Q. If a relation R is defined from a set A = {2,3,4,5} to a set B = {3,6,7,10} as follows $(x,y) \in R \Leftrightarrow x$ divides y.Expression of R^{-1} is represented by

A {(6,2), (10,2), (3,3), (6,3)}

B {(6,2), (3,3),(10,5),(10,2)}

C {(6,2), (10,2), (3,3),(6,3),(10,5)}

D None of these

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Q. If a relation R is defined from a set A = {2,3,4,5} to a set B = {3,6,7,10} as follows $(x,y) \in R \Leftrightarrow x$ divides y.Expression of R^{-1} is represented by

A {(6,2), (10,2), (3,3), (6,3)}

B {(6,2), (3,3),(10,5),(10,2)}

C {(6,2), (10,2), (3,3),(6,3),(10,5)}

D None of these

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Solution:

$R \to (a, b)$

a divides b

Let

$(i) a = 2$ $\qquad$ $(ii) a = 3$

$b = 6, 10$ $\qquad$ $b = 3, 6$

$(iii)\ a = 4$ $\qquad$ $(iv) a = 5$

$b = \phi$ $\qquad$ $b = 10$

$(5, 10)$

$\therefore \quad R = \{(2,6), (2,10), (3,3), (3,6), (5,10)\}$

$\therefore \quad R^{-1} = \{(6,2), (10,2), (3,3), (6,3), (10,5)\}$

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Q. Let n(A) = 8 and n(B) = p.Then ,the total number of non-empty relations that can be defined from A to B is

A 8^p

B $n^p - 1$

C $8p - 1$

D $2^{8p} - 1$

Relations & Functions - Lesson 1

Q. Let n(A) = 8 and n(B) = p.Then ,the total number of non-empty relations that can be defined from A to B is

A 8^p

B $n^p - 1$

C $8p - 1$

D $2^{8p} - 1$

Relations & Functions - Lesson 1

Solution:

We have ,

$\text{n}(A) = 8, n(B) = p$

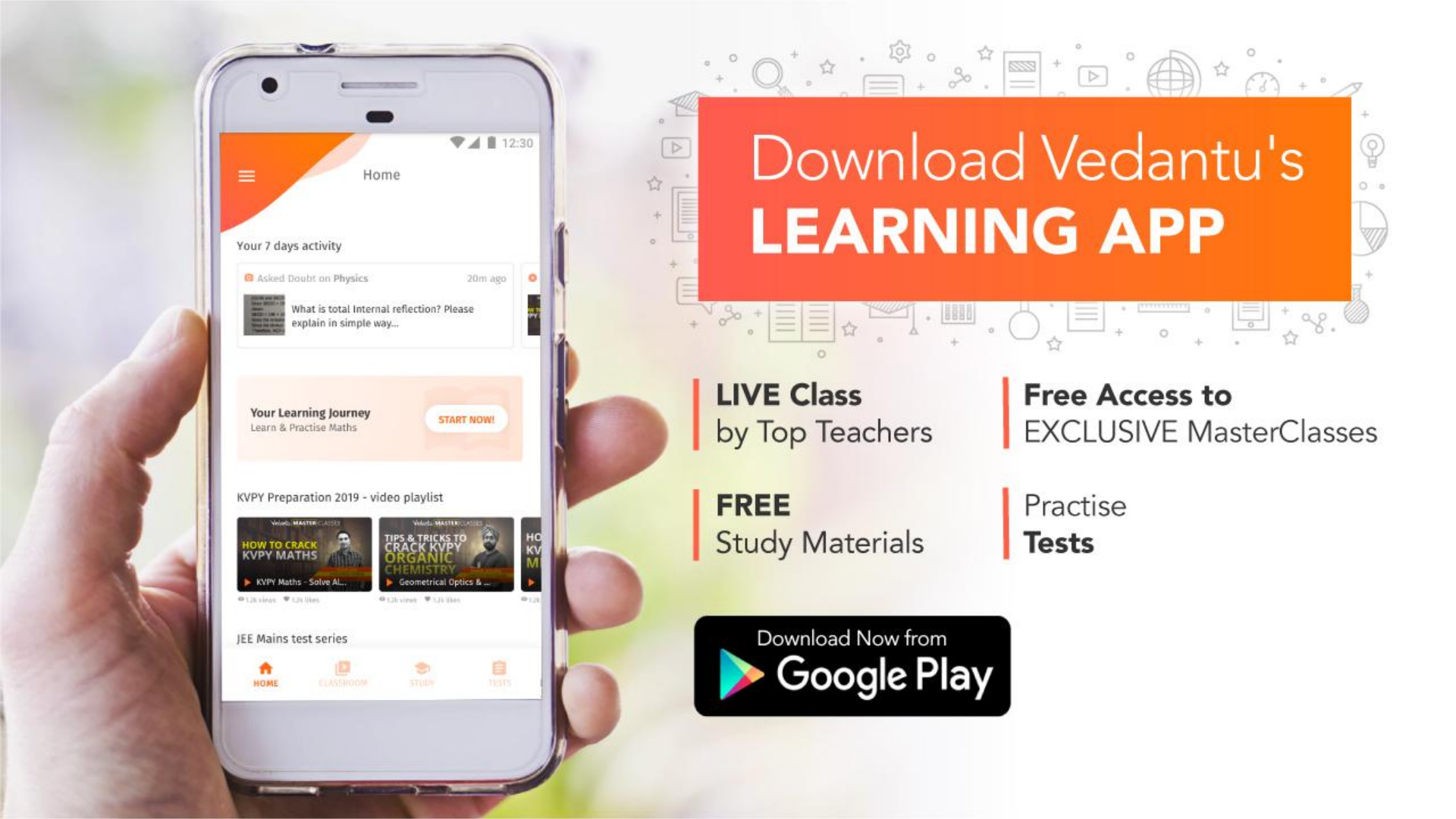
$\therefore n(A \times B) = \text{n}(A).n(B)$

$= 8p$

Total number of relations from A to B

= Number of subsets of $A \times B = 2^{8p}$

$\therefore$ Total number of non - empty relations $= (2^{8p} - 1)$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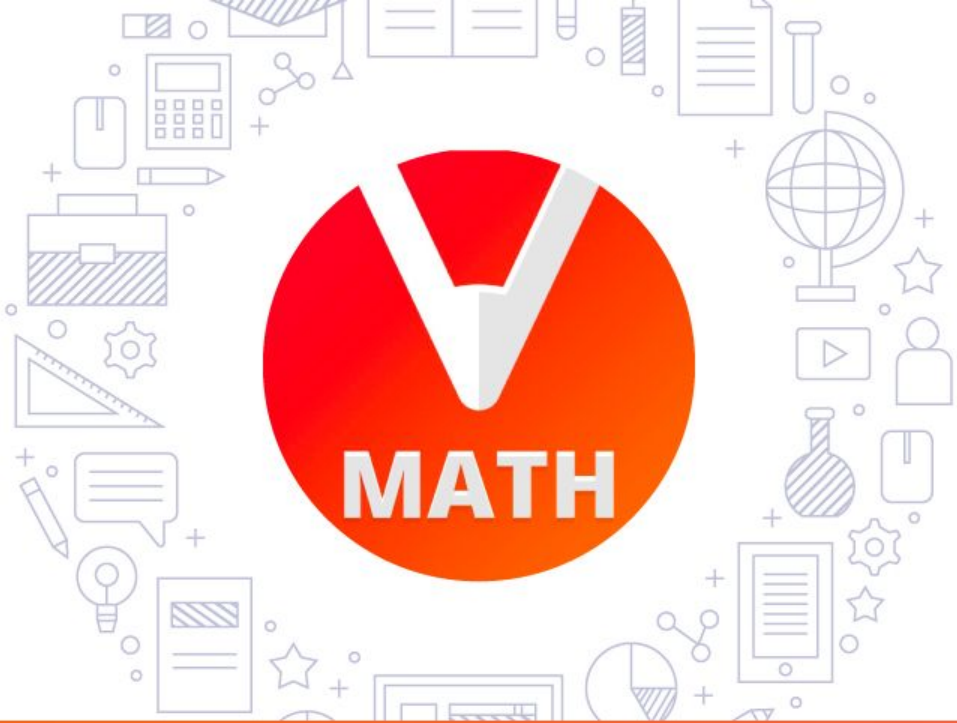

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Thank You

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Question

If $A = \{2, 5\}$ $B = \{3, 4, 7\}$ $C = \{3, 4, 8\}$

Prove (i) $A \times (B \cup C) = (A \times B) \cup (A \times C)$

(ii) $(A - B) \times C = (A \times C) - (B \times C)$

Solution

$(A - B) = \{2, 5\}$

$(A - B) \times C = \{2, 5\} \times \{3, 4, 8\}$

$(A - B) \times C = (2, 3), (2, 4), (2, 8), (5, 3), (5, 4), (5, 8)\}$

Relations & Functions - Lesson 1

Question

If A = {2, 5} B = {3, 4, 7} C = {3, 4, 8}

Prove (i) $A \times (B \cup C) = (A \times B) \cup (A \times C)$

(ii) $(A - B) \times C = (A \times C) - (B \times C)$

Solution

$(A - B) \times C = \{(2, 3), (2, 4), (2, 8), (5, 3), (5, 4), (5, 8)\}$

$A \times C = \{(2, 3), (2, 4), (2, 8),$

$(5, 3), (5, 4), (5, 8)\}$

$B \times C = \{(3, 3),(3, 4) (3, 8), (4, 3), (4, 4),$

$(4, 8), (7, 3), (7, 4), (7, 8)\}$

$(A \times C) - (B \times C) = \{(2, 3) (2, 4) (2, 8), (5, 3), (5, 4), (5, 8)\}$