RD Sharma Solutions Class 11 Maths Chapter 2 Ex 2.1

Class 11 Solutions Chapter 2 Relations Ex 2.1 Q1

By the definition of equality of ordered pairs

$$\left(\frac{a}{3}+1,\ b-\frac{2}{3}\right)=\left(\frac{5}{3},\ \frac{1}{3}\right)$$

$$\Rightarrow \quad \frac{a}{3}+1=\frac{5}{3} \quad \text{and} \quad b-\frac{2}{3}=\frac{1}{3}$$

$$\Rightarrow \quad \frac{a}{3}=\frac{5}{3}-1 \quad \text{and} \quad b=\frac{1}{3}+\frac{2}{3}$$

$$\Rightarrow \quad \frac{a}{3}=\frac{5-3}{3} \quad \text{and} \quad b=\frac{1+2}{3}$$

$$\Rightarrow \quad \frac{a}{3}=\frac{2}{3} \quad \text{and} \quad b=\frac{3}{3}$$

$$\Rightarrow \quad a=2 \quad \text{and} \quad b=1$$

By the definition of equality of ordered pairs

$$(x+1,1)=(3,y-2)$$

$$\Rightarrow \quad x+1=3 \quad \text{and} \quad 1=y-2$$

$$\Rightarrow \quad x=3-1 \quad \text{and} \quad 1+2=y$$

$$\Rightarrow \quad x=2 \quad \text{and} \quad 3=y$$

$$\Rightarrow \quad x=2 \quad \text{and} \quad y=3$$

Class 11 Solutions Chapter 2 Relations Ex 2.1 Q2

We have,

$$(x,-1)\in\{(a,b):b=2a-3\}$$

and, $(5,y)\in\{(a,b):b=2a-3\}$

$$\Rightarrow \quad -1=2\times x-3 \quad \text{and} \quad y=2\times 5-3$$

$$\Rightarrow \quad -1=2x-3 \quad \text{and} \quad y=10-3$$

$$\Rightarrow \quad 3-1=2x \quad \text{and} \quad y=7$$

$$\Rightarrow \quad 2=2x \quad \text{and} \quad y=7$$

$$\Rightarrow \quad x=1 \quad \text{and} \quad y=7$$

Class 11 Solutions Chapter 2 Relations Ex 2.1 Q3

We have,

$$a+b=5$$

$$\Rightarrow \quad a=5-b$$

$$\therefore \quad b=0\Rightarrow a=5-0=5,$$

$$b=3\Rightarrow a=5-3=2,$$

$$b=6\Rightarrow a=5-6=-1,$$

Hence, the required set of ordered pairs (a,b) is $\{(-1,6),(2,3),(5,0)\}$

Class 11 Solutions Chapter 2 Relations Ex 2.1 Q4

We have,

$$a\in\{2,4,6,9\}$$

and, $b\in\{4,6,18,27\}$

Now, a/b stands for 'a divides b'. For the elements of the given sets, we find that $2/4,\ 2/6,\ 2/18,\ 6/18,\ 9/18$ and $9/27$

$\therefore$ $\{(2,4),\ (2,6),\ (2,18),\ (6,18),\ (9,18),\ (9,27)\}$ are the required set of ordered pairs (a,b).

Class 11 Solutions Chapter 2 Relations Ex 2.1 Q5

We have,

$$A=\{1,2\} \text{ and } B=\{1,3\}$$

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

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

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

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

Class 11 Solutions Chapter 2 Relations Ex 2.1 Q6

We have,

$$A=\{1,2,3\} \text{ and } B=\{3,4\}$$

$$\therefore \quad A\times B=\{1,2,3\}\times\{3,4\}$$

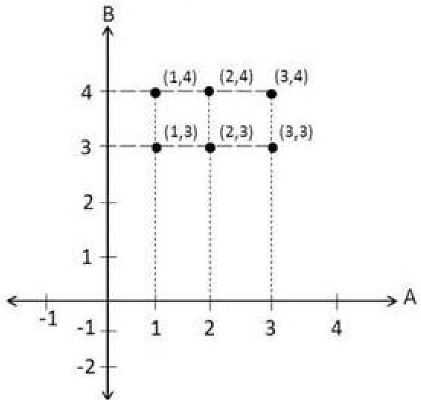
$$=\{(1,3),\ (1,4),\ (2,3),\ (2,4),\ (3,3),\ (3,4)\}$$

In order to represent $A \times B$ graphically, we follow the following steps:

(a) Draw two mutually perpendicular line one horizontal and other vertical.

(b) On the horizontal line represent the element of set A and on the vertical line represent the elements of set B.

(c) Draw vertical dotted lines through points representing elements of A on horizontal line and horizontal lines through points representing elements of B on the vertical line points of intersection of these lines will represent $A \times B$ graphically.



Class 11 Solutions Chapter 2 Relations Ex 2.1 Q7

We have,

$A = \{1,2,3\}$ and $B = \{2,4\}$

$\therefore \quad A \times B = \{1,2,3\} \times \{2,4\}$

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

$B \times A = \{2,4\} \times \{1,2,3\}$

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

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

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

$B \times B = \{2,4\} \times \{2,4\}$

$= \{(2,2),\ (2,4),\ (4,2),\ (4,4)\},$

and, $(A \times B) \cap (B \times A)$

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

$= \{(2,2)\}$

$\Rightarrow \quad (A \times B) \cap (B \times A) = \{(2,2)\}.$

Class 11 Solutions Chapter 2 Relations Ex 2.1 Q8

We have,

$n(A) = 5$ and $n(B) = 4$

We know that, if A and B are two finite sets, then $n(A \times B) = n(A) \times n(B)$

$\therefore \quad n(A \times B) = 5 \times 4 = 20$

Now,

$n[(A \times B) \cap (B \times A)] = 3 \times 3 = 9$ $\quad [\because A$ and B have 3 elements in common$]$

Class 11 Solutions Chapter 2 Relations Ex 2.1 Q9

Let (a,b) be an arbitrary element of $(A \times B) \cap (B \times A)$. Then,

$(a,b) \in (A \times B) \cap (B \times A)$

$\Leftrightarrow \quad (a,b) \in A \times B \quad$ and $\quad (a,b) \in B \times A$

$\Leftrightarrow \quad (a \in A \text{ and } b \in B) \quad$ and $\quad (a \in B \text{ and } b \in A)$

$\Leftrightarrow \quad (a \in A \text{ and } a \in B) \quad$ and $\quad (b \in A \text{ and } b \in B)$

$\Leftrightarrow \quad a \in A \cap B \quad$ and $\quad b \in A \cap B$

Hence, the sets $A \times B$ and $B \times A$ have an element in comon
have an element in common.

Chapter 2 Relations Ex 2.1 Q10

Since $(x,1)$, $(y,2)$, $(z,1)$ are elements of $A \times B$. Therefore, $x, y, z \in A$ and $1,2 \in B$

It is given that $n(A) = 3$ and $n(B) = 2$

$\therefore \quad x, y, z \in A$ and $n(A) = 3$

$\Rightarrow \quad A = \{x, y, z\}$

$1,2 \in B$ and $n(B) = 2$

$\Rightarrow \quad B = \{1,2\}$.

Chapter 2 Relations Ex 2.1 Q11

We have,

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

and, $R = \{(a,b) = a \in A,\ b \in A,\ a \text{ divides } b\}$

Now,

a/b stands for 'a divides b'. For the elements of the given sets, we find that 1/1, 1/2, 1/3, 1/4, 2/2, 3/3 and 4/4

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

Chapter 2 Relations Ex 2.1 Q12

We have,

$A = \{-1,1\}$

$\therefore \quad A \times A = \{-1,1\} \times \{-1,1\}$

$= \{(-1,-1), (-1,1), (1,-1), (1,1)\}$

$\therefore \quad A \times A \times A = \{-1,1\} \times \{(-1,-1), (-1,1), (1,-1), (1,1)\}$

$= \{(-1,-1,-1), (-1,-1,1), (-1,1,-1), (-1,1,1), (1,-1,-1), (1,-1,1), (1,1,-1), (1,1,1)\}$

Chapter 2 Relations Ex 2.1 Q13

(i) False,

If $P = \{m,n\}$ and $Q = \{n,m\}$,

Then,

$P \times Q = \{(m,n), (m,m), (n,n), (n,m)\}$

(ii) False,

If A and B are non-empty sets, then AB is a non-empty set of ordered pairs (x,y) such that $x \in A$ and $y \in B$.

(iii) True

Chapter 2 Relations Ex 2.1 Q14

We have,

$A = \{1,2\}$

$\therefore \quad A \times A = \{1,2\} \times \{1,2\}$

$= \{(1,1), (1,2), (2,1), (2,2)\}$

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

$= \{(1,1,1), (1,1,2), (1,2,1), (1,2,2), (2,1,1), (2,1,2), (2,2,1), (2,2,2)\}$

Chapter 2 Relations Ex 2.1 Q15

We have,

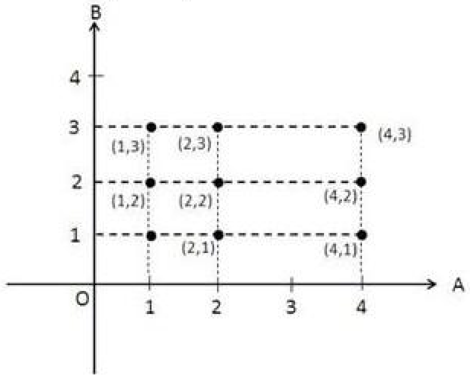
$A = \{1,2,4\}$ and $B = \{1,2,3\}$

$\therefore \quad A \times B = \{1,2,4\} \times \{1,2,3\}$

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

Hence, we represent A on the horizontal line and B on vertical line.

Graphical representation of $A \times B$ is as shown below:



We have,

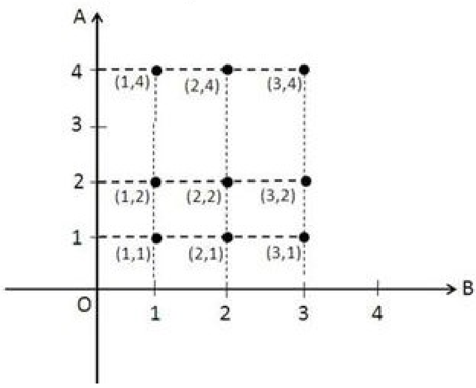
$A = \{1, 2, 4\}$ and $B = \{1, 2, 3\}$

$\therefore \quad B \times A = \{1, 2, 3\} \times \{1, 2, 4\}$

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

Hence, we represent B on the horizontal line and A on vertical line.

Graphical representation of $B \times A$ is as shown below:



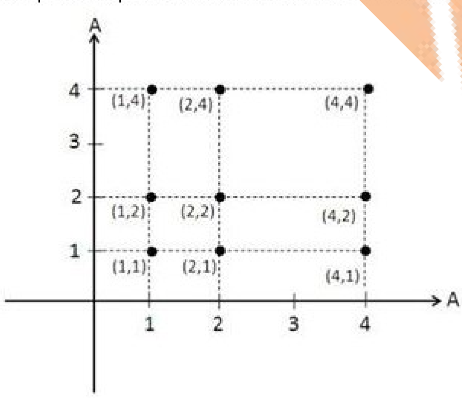
We have,

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

$\therefore \quad A \times A = \{1, 2, 4\} \times \{1, 2, 4\}$

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

Graphical representation of $A \times A$ is shown below:



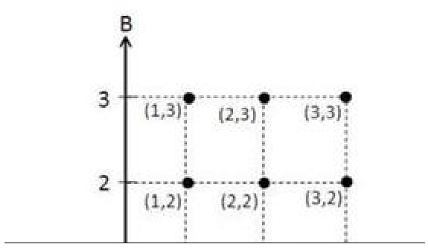
We have,

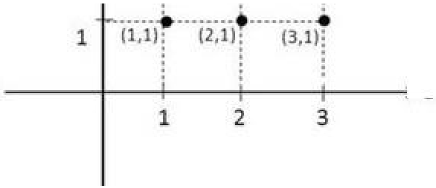
$B = \{1, 2, 3\}$

$\therefore \quad B \times B = \{1, 2, 3\} \times \{1, 2, 3\}$

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

Graphical representation of $B \times B$ is shown below:





1
(1,1)
(2,1)
(3,1)
1
2
3

RD Sharma Solutions Class 11 Maths Chapter 2 Ex 2.2

Class 11 Solutions Chapter 2 Relations Ex 2.2 Q1

We have,

$$A = \{1, 2, 3\},\ B = \{3, 4\} \text{ and } C = \{4, 5, 6\}$$

$$\therefore \quad A \times B = \{1, 2, 3\} \times \{3, 4\}$$

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

and, $$B \times C = \{3, 4\} \times \{4, 5, 6\}$$

$$= \{(3, 4),\ (3, 5),\ (3, 6),\ (4, 4),\ (4, 5),\ (4, 6)\}$$

$$\therefore \quad (A \times B) \cap (B \times C) = \{3, 4\}.$$

Class 11 Solutions Chapter 2 Relations Ex 2.2 Q2

We have,

$$A = \{2, 3\},\ B = \{4, 5\} \text{ and } C = \{5, 6\}$$

$$\therefore \quad B \cup C = \{4, 5\} \cup \{5, 6\}$$

$$= \{4, 5, 6\}$$

$$\therefore \quad A \times (B \cup C) = \{2, 3\} \times \{4, 5, 6\}$$

$$= \{(2, 4),\ (2, 5),\ (2, 6),\ (3, 4),\ (3, 5),\ (3, 6)\}$$

Now,

$$B \cap C = \{4, 5\} \cap \{5, 6\} = \{5\}$$

$$\therefore \quad A \times (B \cap C) = \{2, 3\} \times \{5\}$$

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

Now,

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

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

and, $$A \times C = \{2, 3\} \times \{5, 6\}$$

$$= \{(2, 5),\ (2, 6),\ (3, 5),\ (3, 6)\}$$

$$\therefore \quad (A \times B) \cup (A \times C) = \{(2, 4),\ (2, 5),\ (2, 6),\ (3, 4),\ (3, 5),\ (3, 6)\}$$

Class 11 Solutions Chapter 2 Relations Ex 2.2 Q3

We have,

$$A = \{1, 2, 3\},\ B = \{4\} \text{ and } C = \{5\}$$

$$\therefore \quad B \cup C = \{4\} \cup \{5\} = \{4, 5\}$$

$$\therefore \quad A \times (B \cup C) = \{1, 2, 3\} \times \{4, 5\}$$

$$\Rightarrow \quad A \times (B \cup C) = \{(1, 4),\ (1, 5),\ (2, 4),\ (2, 5),\ (3, 4),\ (3, 5)\} \qquad \text{---(i)}$$

Now,

$$A \times B = \{1, 2, 3\} \times \{4\}$$

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

and, $$A \times C = \{1, 2, 3\} \times \{5\}$$

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

$$\therefore \quad (A \times B) \cup (A \times C) = \{(1, 4),\ (2, 4),\ (3, 4)\} \cup \{(1, 5),\ (2, 5),\ (3, 5)\}$$

$$\Rightarrow \quad (A \times B) \cup (A \times C) = \{(1, 4),\ (1, 5),\ (2, 4),\ (2, 5),\ (3, 4),\ (3, 5)\} \qquad \text{---(ii)}$$

From equation(i) and(ii), we get

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

Hence verified.

We have,

$$A = \{1, 2, 3\},\ B = \{4\} \text{ and } C = \{5\}$$

$$\therefore \quad B \cap C = \{4\} \cap \{5\} = \phi$$

$$\therefore \quad A \times (B \cap C) = \{1, 2, 3\} \times \phi$$

$$\Rightarrow \quad A \times (B \cap C) = \phi \qquad \text{---(i)}$$

Now,

$$A \times B = \{1, 2, 3\} \times \{4\}$$

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

and, $A \times C = \{1,2,3\} \times \{5\}$

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

$\therefore \quad (A \times B) \cap (A \times C) = \{(1,4),\ (2,4),\ (3,4)\} \cap$

$\Rightarrow \quad (A \times B) \cap (A \times C) = \phi$ ---(ii)

From equation(i) and equation(ii), we get

$A \times (B \cap C) = (A \times B) \cap (A \times C)$

Hence verified.

We have,

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

$\therefore \quad B - C = \{4\}$

$\therefore \quad A \times (B - C) = \{1,2,3\} \times \{4\}$

$\Rightarrow \quad A \times (B - C) = \{(1,4),\ (2,4),\ (3,4)\}$ ---(i)

Now,

$A \times B = \{1,2,3\} \times \{4\}$

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

and, $A \times C = \{1,2,3\} \times \{5\}$

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

$\therefore \quad (A \times B) - (A \times C) = \{(1,4),\ (2,4),\ (3,4)\}$ ---(ii)

From equation(i) and equation(ii), we get

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

Hence verified.

Class 11 Solutions Chapter 2 Relations Ex 2.2 Q4

We have,

$A = \{1,2\},\ B = \{1,2,3,4\},\ C = \{5,6\}$ and $D = \{5,6,7,8\}$

$\therefore \quad B \times D = \{1,2,3,4\} \times \{5,6,7,8\}$

$$= \begin{Bmatrix} (1,5), & (1,6), & (1,7), & (1,8), & (2,5), & (2,6), & (2,7), & (2,8), \\ (3,5), & (3,6), & (3,7), & (3,8), & (4,5), & (4,6), & (4,7), & (4,8) \end{Bmatrix} \quad \text{---(i)}$$

and, $A \times C = (1,2) \times (5,6)$

$= \{(1,5),\ (1,6),\ (2,5),\ (2,6)\}$ ---(ii)

Clearly from equation(i) and equation(ii), we get

$A \times C \subset B \times D$

Hence verified.

We have,

$A = \{1,2\},\ B = \{1,2,3,4\},\ C = \{5,6\}$ and $D = \{5,6,7,8\}$

$\therefore \quad B \cap \cap C = \{1,2,3,4\} \cap \{5,6\} = \phi$

$A \times (B \cap C) = \{1,2\} \times \phi = \phi$ ---(i)

Now,

$A \times B = \{1,2\} \times \{1,2,3,4\}$

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

and, $A \times C = \{1,2\} \times \{5,6\}$

$= \{(1,5),\ (1,6),\ (2,5),\ (2,6)\}$

$\therefore \quad (A \times B) \cap (A \times C) = \theta$ ---(ii)

From equation(i) and equation(ii), we get

$A \times (B \cap C) = (A \times B) \cap (A \times C)$

Hence verified.

Class 11 Solutions Chapter 2 Relations Ex 2.2 Q5

(i) we have,

$A = \{1,2,3,\},\ B = \{3,4\}$ and $C = \{4,5,6\}$

$B \cap C = \{3,4\} \cap \{4,5,6\} = \{4\}$

$\therefore \quad B \cap C = \{3,4\} \cap \{4,5,6\} = \{4\}$

$\therefore \quad A \times (B \cap C) = \{1,2,3,\} \times \{4\}$
$\quad = \{(1,4),\ (2,4),\ (3,4)\}$
$\Rightarrow \quad A \times (B \cap C) = \{(1,4),\ (2,4),\ (3,4)\}$

(ii) We have,
$A = \{1,2,3,\},\ B = \{3,4\}$ and $C = \{4,5,6\}$

$\therefore \quad A \times B = \{1,2,3,\} \times \{3,4\}$
$\quad = \{(1,3),\ (1,4),\ (2,3),\ (2,4),\ (3,3),\ (3,4)\}$

and,
$A \times C = \{1,2,3,\} \times \{4,5,6\}$
$\quad = \{(1,4),\ (1,5),\ (1,6),\ (2,4),\ (2,5),\ (2,6),\ (3,4),\ (3,5),\ (3,6)\}$

$(A \times B) \cap (A \times C) = \{(1,4),\ (2,4),\ (3,4)\}$

(iii) we have,
$A = \{1,2,3,\},\ B = \{3,4\}$ and $C = \{4,5,6\}$

$\therefore \quad B \cup C = \{3,4\} \cup \{4,5,6\}$
$\quad = \{3,4,5,6\}$

$\therefore \quad A \times (B \cup C) = \{1,2,3,\} \times \{3,4,5,6\}$
$\quad = \{(1,3),\ (1,4),\ (1,5),\ (1,6),\ (2,3),\ (2,4),\ (2,5),\ (2,6),\ (3,3),(3,4),\ (3,5),\ (3,6)\}$

Class 11 Solutions Chapter 2 Relations Ex 2.2 Q6

Let (a,b) be an arbitrary element of $(A \cup B) \times C$. Then,

$(a,b) \in (A \cup B) \times C$
$\Rightarrow \quad a \in A \cup B$ and $b \in C$ [By defination]
$\Rightarrow \quad (a \in A$ or $a \in B)$ and $b \in C$ [By defination]
$\Rightarrow \quad (a \in A$ and $b \in C)$ or $(a \in B$ and $b \in C)$
$\Rightarrow \quad (a,b) \in A \times C$ or $(a,b) \in B \times C$
$\Rightarrow \quad (a,b) \in (A \times C) \cup (B \times C)$
$\Rightarrow \quad (a,b) \in (A \cup B) \times C$
$\Rightarrow \quad (a,b) \in (A \times C) \cup (B \times C)$
$\Rightarrow \quad (A \cup B) \times C \subseteq (A \times C) \cup (B \times C)$ ---(i)

Again, let (x,y) be an arbitrary element of $(A \times C) \cup (B \times C)$. Then,
$(x,y) \in (A \times C) \cup (B \times C)$
$\Rightarrow \quad (x,y) \in A \times C$ or $(x,y) \in B \times C$
$\Rightarrow \quad x \in A$ and $y \in C$ or $x \in B$ and $y \in C$
$\Rightarrow \quad (x \in A$ or $x \in B)$ and $y \in C$
$\Rightarrow \quad x \in A \cup B$ and $y \in C$
$\Rightarrow \quad (x,y) \in (A \cup B) \times C$
$\Rightarrow \quad (x,y) \in (A \times C) \cup (B \times C)$
$\Rightarrow \quad (x,y) \in (A \cup B) \times C$
$\Rightarrow \quad (A \times C) \cup (B \times C) \subseteq (A \cup B) \times C$ ---(ii)

Using equation(i) and equation(ii), we get
$(A \cup B) \times C = (A \times C) \cup (B \times C)$

Hence proved.

Let (a,b) be an arbitrary element of $(A \cap B) \times C$. Then,

$(a,b) \in (A \cap B) \times C$
$\Rightarrow \quad a \in A \cap B$ and $b \in C$
$\Rightarrow \quad (a \in A$ and $a \in B)$ and $b \in C$ [By defination]
$\Rightarrow \quad (a \in A$ and $b \in C)$ and $(a \in B$ and $b \in C)$

$\Rightarrow \quad (a,b) \in A \times C \quad$ and $(a,b) \in B \times C$

$\Rightarrow \quad (a,b) \in (A \times C) \cap (B \times C)$

$\Rightarrow \quad (a,b) \in (A \cap B) \times C$

$\Rightarrow \quad (a,b) \in (A \times C) \cap (B \times C)$

$\Rightarrow \quad (A \cap B) \times C \subseteq (A \times C) \cap (B \times C) \qquad$ ---(i)

Let (x,y) be an arbitrary element of $(A \times C) \cap (B \times C)$. Then,

$(x,y) \in (A \times C) \cap (B \times C)$

$\Rightarrow \quad (x,y) \in A \times C \quad$ and $\quad (x,y) \in B \times C \qquad$ [By defination]

$\Rightarrow \quad (x \in A$ and $y \in C) \quad$ and $\quad (x \in B$ and $y \in C)$

$\Rightarrow \quad (x \in A$ and $x \in B) \quad$ and $\quad y \in C$

$\Rightarrow \quad x \in A \cap B \quad$ and $\quad y \in C$

$\Rightarrow \quad (x,y) \in (A \cap B) \times C$

$\Rightarrow \quad (x,y) \in (A \times C) \cap (B \times C)$

$\Rightarrow \quad (x,y) \in (A \cap B) \times C$

$\Rightarrow \quad (A \times C) \cap (B \times C) \subseteq (A \cap B) \times C \qquad$ ---(ii)

Using equation (i) and equation (ii), we get

$(A \cap B) \times C = (A \times C) \cap (B \times C)$

Class 11 Solutions Chapter 2 Relations Ex 2.2 Q7

Let (a,b) be an arbitrary element of $A \times B$. then,

$(a,b) \in A \times B$

$\Rightarrow \quad a \in A \quad$ and $\quad b \in B \qquad$ ---(i)

Now,

$(a,b) \in A \times B$

$\Rightarrow \quad (a,b) \in C \times D \qquad [\because A \times B \subseteq C \times D]$

$\Rightarrow \quad a \in C$ and $b \in D \qquad$ ---(ii)

$\therefore \quad a \in A \Rightarrow a \in C \qquad$ [Using (i) and (ii)]

$\Rightarrow \quad A \subseteq C$

and,

$b \in B \Rightarrow b \in D$

$\Rightarrow \quad B \subseteq D$

Hence, proved

RD Sharma Solutions Class 11 Maths Chapter 2 Ex 2.3

RD Sharma Class 11 Solutions Chapter 2 Relations Ex 2.3 Q1

(i) We have,

$A = \{1, 2, 3\}$ and $B = \{4, 5, 6\}$

$\{(1,6), (3,4), (5,2)\}$ is not a relation from A to B as it is not a subset of $A \times B$.

(ii) We have,

$A = \{1, 2, 3\}$ and $B = \{4, 5, 6\}$

$\{(1,5), (2,6), (3,4), (3,6)\}$ is a subset of $A \times B$, so it is a relation from A to B.

(iii) We have,

$A = \{1, 2, 3\}$ and $B = \{4, 5, 6\}$

$\{(4,2), (4,3), (5,1)\}$ is not a relation from A to B as it is not a subset of $A \times B$.

(iv) We have,

$A = \{1, 2, 3\}$ and $B = \{4, 5, 6\}$

$A \times B$ is a relation from A to B.

Class 11 Solutions Chapter 2 Relations Ex 2.3 Q2

We have,

$A = \{2,3,4,5\}$ and $B = \{3,6,7,10\}$

It is given that $(x,y) \in R \Leftrightarrow x$ is relatively prime to y

$\therefore \quad (2,3) \in R,\ (2,7) \in R,\ (3,7) \in R,\ (3,10) \in R,\ (4,3) \in R,\ (4,7) \in R,\ (5,3) \in R,$ and $(5,7) \in R$

Thus,

$$R = \{(2,3),\ (2,7),\ (3,7),\ (3,10),\ (4,3),\ (4,7),\ (5,3),\ (5,7)\}$$

Clearly, Domain $(R) = \{2,3,4,5\}$ and Range $= \{3,7,10\}$.

Class 11 Solutions Chapter 2 Relations Ex 2.3 Q3

We have,

$A = \{1,2,3,4,5\}$ $\quad [\because A$ is the set of first five natural number$]$

It is given that R be a relation on A defined as $(x,y) \in R \Leftrightarrow x \le y$

For the elements of the given sets A and A, we find that

$1 = 1,\ 1 < 2,\ 1 < 3,\ 1 < 4,\ 1 < 5,\ 2 = 2,\ 2 < 3,\ 2 < 4,\ 2 < 5,\ 3 = 3,\ 3 < 4,\ 3 < 5,\ 4 = 4,\ 4 < 5,$ and $5 = 5$

$\therefore \quad (1,1) \in R,\ (1,2) \in R,\ (1,3) \in R,\ (1,4) \in R,\ (1,5) \in R,\ (2,2) \in R,\ (2,3) \in R,\ (2,4) \in R,\ (2,5) \in R,$
$(3,3) \in R,\ (3,4) \in R,\ (3,5) \in R,\ (4,4) \in R,\ (4,5) \in R,$ and $(5,5) \in R$

Thus,

$$R = \left\{\begin{matrix}(1,1),\ (1,2),\ (1,3),\ (1,4),\ (1,5),\ (2,2),\ (2,3),\ (2,4),\ (2,5),\ (3,3),\ (3,4),\ (3,5),\ (4,4), \\ (4,5),\ (5,5)\end{matrix}\right\}$$

Also,

$$R^{-1} = \left\{\begin{matrix}(1,1),\ (2,1),\ (3,1),\ (4,1),\ (5,1),\ (2,2),\ (3,2),\ (4,2),\ (5,2),\ (3,3),\ (4,3),\ (5,3),\ (4,4), \\ (5,4),\ (5,5)\end{matrix}\right\}$$

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

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

Class 11 Solutions Chapter 2 Relations Ex 2.3 Q4

(i) We have,

$R = \{(1,2),\ (1,3),\ (2,3),\ (3,2),\ (5,6)\}$

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

(ii) We have,

$R = \{(x,y) : x, y \in N, x + 2y = 8\}$

Now,

$x + 2y = 8$

$\Rightarrow \quad x = 8 - 2y$

Putting $y = 1,2,3$ we get $x = 6,4,2$ respectively.

For $y = 4$, we get $x = 0 \notin N$. Also for $y > 4$, $x \notin N$

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

Thus,

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

$\Rightarrow \quad R^{-1} = \{(3,2),\ (2,4),\ (1,6)\}$

(iii) We have,

R is a relation from $\{11,12,13,\}$ to $\{8,10,12,\}$ defined by $y = x - 3$

Now,

$y = x - 3$

Putting $x = 11,12,13$ we get $y = 8,9,10$ respectively

$\Rightarrow \quad (11,8) \in R,\ (12,9) \notin R$ and $(13,10) \in R$

Thus,

$R = \{(11,8),\ (13,10)\}$

$\Rightarrow \quad R^{-1} = \{(8,11),\ (10,13)\}$

Class 11 Solutions Chapter 2 Relations Ex 2.3 Q5

(i) We have,

$x = 2y$

Putting $y = 1, 2, 3$ we get $x = 2, 4, 6$ respectively.

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

(ii) We have,

It is given that relation R on the set $\{1,2,3,4,5,6,7\}$ defined by $(x, y) \in R \Leftrightarrow x$ is relatively prime to y.

$\therefore \quad (2,3) \in R, (2,5) \in R, (2,7) \in R, (3,2) \in R, (3,4) \in R, (3,5) \in R, (3,7) \in R, (4,3) \in R, (4,5) \in R, (4,7) \in R, (5,2) \in R, (5,3) \in R, (5,4) \in R, (5,6) \in R, (5,7) \in R, (6,5) \in R, (6,7) \in R, (7,2) \in R, (7,3) \in R, (7,4) \in R, (7,5) \in R$ and $(7,6) \in R$.

Thus,

$$R = \left\{\begin{matrix}(2,3), (2,5), (2,7), (3,2), (3,4), (3,5), (3,7), (4,3), (4,5), (4,7), (5,2), \\ (5,3), (5,4), (5,6), (5,7), (6,5), (6,7), (7,2), (7,3), (7,4), (7,5), (7,6).\end{matrix}\right\}$$

(iii) We have,

$2x + 3y = 12$

$\Rightarrow \quad 2x = 12 - 3y$

$\Rightarrow \quad x = \dfrac{12 - 3y}{2}$

Putting $y = 0, 2, 4$ we get $x = 6, 3, 0$ respectively.

For $y = 1,3,5,6,7,8,9,10$, $x \notin$ given set

$\therefore \quad R = \{(6,0), (3,2), (0,4)\}$

$= \{(0,4), (3,2), (6,0)\}$

(iv) We have,

$A = (5,6,7,8)$ and $B = (10,12,15,16,18)$

Now,

a/b stands for 'a divides b'. For the elements of the given set A and B, we find that $5/10$, $5/15$, $6/12$, $6/18$ and $8/16$

$\therefore \quad (5,10) \in R, (5,15) \in R, (6,12) \in R, (6,18) \in R$, and $(8,16) \in R$

Thus,

$R = \{(5,10), (5,15), (6,12), (6,18), (8,16)\}$

Class 11 Solutions Chapter 2 Relations Ex 2.3 Q6

We have,

$(x, y) \in R \Leftrightarrow x + 2y = 8$

Now,

$x + 2y = 8$

$\Rightarrow \quad x = 8 - 2y$

Putting $y = 1, 2, 3$, we get $x = 6, 4, 2$ respectively

For $y = 4$, we get $x = 0 \notin N$

Also, for $y > 4$, $x \notin N$

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

Thus,

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

$\Rightarrow \quad R^{-1} = \{(3,2), (2,4), (1,6)\}$

Class 11 Solutions Chapter 2 Relations Ex 2.3 Q7

We have,

$A = \{3,5\}, \quad B = \{7,11\}$

and, $R = \{(a,b) : a \in A, b \in B, a - b \text{ is odd}\}$

For the elements of the given sets A and B, we find that

$3 - 7 = -4$, $3 - 11 = -8$, $5 - 7 = -2$ and $5 - 11 = -6$

$\therefore \quad (3,7) \notin R,\ (3,11) \notin R,\ (5,7) \notin R$ and $(5,11) \notin R,$

Thus, R is an empty relation from A into B.

Class 11 Solutions Chapter 2 Relations Ex 2.3 Q8

We have,

$$A = \{1,2\} \text{ and } B = \{3,4\}$$

$\therefore \quad n(A) = 2$ and $n(B) = 2$

$\Rightarrow \quad n(A) \times n(B) = 2 \times 2 = 4$

$\Rightarrow \quad n(A \times B) = 4 \qquad [\because n(A \times B) = n(A) \times n(B)]$

So, there are $2^4 = 16$ relations from A to B. $\quad \left[\begin{array}{l} \because n(x) = a, n(y) = b \\ \Rightarrow \text{Total number of relations} = 2^{ab} \end{array}\right]$

Class 11 Solutions Chapter 2 Relations Ex 2.3 Q9

(i) We have,

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

For the elements of the given sets, we find that

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

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

(ii) We have,

$$R = \{(x, x^3) : x \text{ is a prime number less than } 10\}$$

For the elements of the given sets, we find that

$$x = 2,3,5,7$$

$\therefore \quad (2,8) \in R,\ (3,27) \in R,\ (5,125) \in R$ and $(7,343) \in R$

$\Rightarrow \quad R = \{(2,8),\ (3,27),\ (5,125),\ (7,343)\}$

Clearly, $\text{Domain}(R) = \{2,3,5,7\}$ and $\text{Range}(R) = \{8,27,125,343\}$

Class 11 Solutions Chapter 2 Relations Ex 2.3 Q10

(i) We have,

$$R = \{(a,b) : a \in N,\ a < 5,\ b = 4\}$$

$\Rightarrow \quad a = 1,2,3,4$ and $b = 4$

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

Clearly, $\text{Domain}(R) = \{1,2,3,4\}$ and $\text{Range}(R) = \{4\}$

(ii) We have,

$$S = \{(a,b) : b = |a-1|,\ a \in z \text{ and } |a| \le 3\}$$

$\Rightarrow \quad a = -3,\ -2,\ -1,\ 0,\ 1,\ 2,\ 3$

For $\quad a = -3,-2,-1,0,1,2,3$ we get

$b = 4,3,2,1,0,1,2$ respectively

Thus, $S = \{(-3,4),\ (-2,3),\ (-1,2),\ (0,1),\ (2,1),\ (3,2)\}$

$\text{Domain}(S) = \{-3,-2,-1,0,1,2,3\}$ and

$\text{Range}(R) = \{0,1,2,3,4\}$

Class 11 Solutions Chapter 2 Relations Ex 2.3 Q11

Here, $A = \{a, b\}$

we know that,

Number of relations $= 2^{mn}$

$= 2^{2.2}$

$= 24$

$= 16$

Number of relations on $A = 16$

Relations on A are given by

$R = \{a, a\}, \{a, b\}, \{b, a\}, \{b, b\}$

$\{(a, a), (a, b)\}, \{(a, a), (b, a)\}, \{(a, a), (b, b)\},$

$\{(a, b), (b, a)\}, \{(a, b), (b, b)\}, \{(b, a), (b, b)\},$

$\{(a, a), (a, b), (b, a)\}, \{(a, b), (b, a), (b, b)\},$

$\{(b, a), (b, b), (a, a)\}, \{(b, b), (a, a), (a, b)\},$

$\{(a, a), (b, a), (b, b)\}, \{(a, a), (b, a), (b, b)\}$

Class 11 Solutions Chapter 2 Relations Ex 2.3 Q12

We have,

$A = \{x, y, z\}$ and $B = \{a, b\}$

$\Rightarrow$ $n(A) = 3$ and $n(B) = 2$

$\Rightarrow$ $n(A) \times n(B) = 3 \times 2 = 6$

$\Rightarrow$ $n(A \times B) = 6$ $\quad [\because n(A \times B) = n(A) \times n(B)]$

So, there are $2^6 = 64$ relations from A to B. $\quad \left[\begin{array}{l} \because n(x) = a, n(y) = b \\ \Rightarrow \text{Total number of relations} = 2^{ab} \end{array}\right]$

Class 11 Solutions Chapter 2 Relations Ex 2.3 Q13

We have,

$R = \{(a, b) : a,\ b \in N \text{ and } a = b^2\}$

(i) This statement is not true because $(5, 5) \notin R$.

(ii) This statement is not true because $(25, 5) \in R$ but $(5, 25) \notin R$.

(iii) This statement is not true because $(36, 6) \in R$ and $(25, 5) \in R$ but $(36, 5) \notin R$.

Class 11 Solutions Chapter 2 Relations Ex 2.3 Q14

We have,

$3x - y = 0$

$\Rightarrow$ $3x = y$

$\Rightarrow$ $y = 3x$

Putting $x = 1, 2, 3, 4$ we get, $y = 3, 6, 9, 12$ respectively

For $x > 4$, we get $y > 14$ which does not belong to set A.

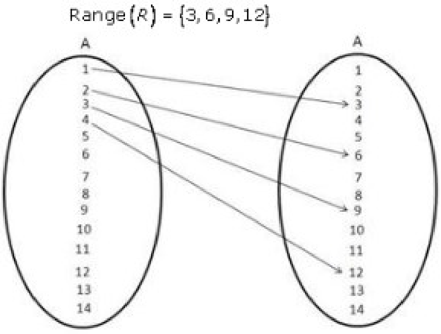
$\therefore$ $R = \{(1, 3),\ (2, 6),\ (3, 9),\ (4, 12)\}$

The arrow diagram representing R is as follows:

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

Co-domain$(R) = \{1, 2, 3, 4 ..., 14\}$ and

Range$(R) = \{3, 6, 9, 12\}$



Class 11 Solutions Chapter 2 Relations Ex 2.3 Q15

We have,

$R = \{(x, y) : y = x + 5,\ x \text{ is a natural number less than } 4,\ x, y \in N\}$

(i) Putting $x = 1, 2, 3$ we get, $y = 6, 7, 8$ respectively

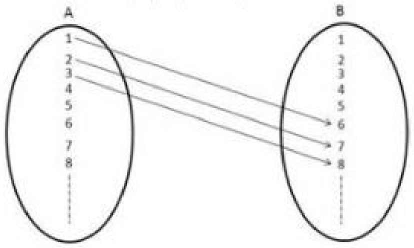
$\therefore$ Relation R in roster form is

$R = \{(1, 6),\ (2, 7),\ (3, 8)\}$

(ii) The arrow diagram representing R is as follows:

Clearly, Domain$(R) = \{1, 2, 3\}$ and

Range$(R) = \{6, 7, 8\}$



Class 11 Solutions Chapter 2 Relations Ex 2.3 Q16

We have,

$A = \{1, 2, 3, 5\}$ and $B = \{4, 6, 9\}$

It is given that,

$R = \{(x, y)$: the difference between x and y is odd, $x \in A,\ y \in B\}$

For the elements of the given sets A and B, we find that

$(1, 4) \in R,\ (1, 6) \in R,\ (2, 9) \in R,\ (3, 4) \in R,\ (3, 6) \in R,\ (5, 4) \in R$ and $(5, 6) \in R$

$\therefore \quad R = \{(1, 4), (1, 6), (2, 9), (3, 4), (3, 6), (5, 4), (5, 6)\}$

Hence, relation R in roster form is $\{(1, 4), (1, 6), (2, 9), (3, 4), (3, 6), (5, 4), (5, 6)\}$

Class 11 Solutions Chapter 2 Relations Ex 2.3 Q17

We have,

$R = \{(x, x^3) : x$ is a prime number less than $10\}$

For the elements of the given sets, we find that

$x = 2, 3, 5, 7$

$\therefore \quad (2, 8) \in R,\ (3, 27) \in R,\ (5, 125) \in R$ and $(7, 343) \in R$

$\therefore$ Relation R in roster form is $= \{(2, 8), (3, 27), (5, 125), (7, 343)\}$

Class 11 Solutions Chapter 2 Relations Ex 2.3 Q18

We have,

$A = \{1, 2, 3, 4, 5, 6\}$

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

(i) Now, a/b stands for 'a divides b'. For the elements of the given sets A and A, we find that

$1/1,\ 1/2,\ 1/3,\ 1/4,\ 1/5,\ 1/6,\ 2/2,\ 2/4,\ 2/6,\ 3/3,\ 3/6,\ 4/4,\ 5/5,\ 6/6$

$\therefore$ Relation R in roster form is

$R = \{(1, 1), (1, 2), (1, 3), (1, 4), (1, 5), (1, 6), (2, 2), (2, 4), (2, 6), (3, 3), (3, 6), (4, 4), (5, 5), (6, 6)\}$

(ii) Domain$(R) = \{1, 2, 3, 4, 5, 6\}$

(iii) Range$(R) = \{1, 2, 3, 4, 5, 6\}$

Class 11 Solutions Chapter 2 Relations Ex 2.3 Q19

(i) Set builder form of the relation from P to Q is

$R = \{(x, y) : y = x - 2,\ x \in P,\ y \in Q\}$

(ii) Roster form of the relation from P to Q is

$R = \{(5, 3), (6, 4), (7, 5)\}$

Domain$(R) = \{5, 6, 7\}$

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

Class 11 Solutions Chapter 2 Relations Ex 2.3 Q20

We have,

$R = \{(a, b) : a,\ b \in Z,\ a - b$ is an integer$\}$

Clearly, Domain$(R) = Z$

Clearly, Domain$(R) = z$,

Range$(R) = z$.

Class 11 Solutions Chapter 2 Relations Ex 2.3 Q21

Let $\left(1, \frac{-1}{2}\right) \in R_1$ and $\left(\frac{-1}{2}, -4\right) \in R_1$

$\Rightarrow$ $1 + 1 \times \frac{-1}{2} > 0$ and $1 + \left(\frac{-1}{2}\right) - 4 > 0$

But, $1 + 1 \times (-4) = 1 - 4$

$= -3 < 0$

So, $(1, -4) \notin R_1$

Class 11 Solutions Chapter 2 Relations Ex 2.3 Q22

We have,

$(a,b) R (c,d) \Leftrightarrow a + d = b + c$ for all (a,b), $(c,d) \in N \times N$

(i) We have,

$a + b = b + a$ for all $a, b \in N$

$\therefore$ $(a,b) R (a,b)$ for all, $a, b \in N$

(ii) Now,

$(a,b) R (c,d)$

$\Rightarrow$ $a + d = b + c$

$\Rightarrow$ $c + b = d + a$

$\Rightarrow$ $(c,d) R (a,b)$

(iii) Now,

$(a,b) R (c,d)$ and $(c,d) R (e,f)$

$\Rightarrow$ $a + d = b + c$ and $c + f = d + e$

$\Rightarrow$ $a + d + c + f = b + c + d + e$ [Adding]

$\Rightarrow$ $a + f = b + e$

$\Rightarrow$ $(a,b) R (e,f)$