

Mathematics

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(Chapter – 1) (Relations and Functions) (Exercise 1.1)

(Class – XII)

Question 1:

Determine whether each of the following relations are reflexive, symmetric and transitive:

- (i) Relation R in the set $A = \{1, 2, 3, \dots, 13, 14\}$ defined as $R = \{(x, y) : 3x - y = 0\}$
- (ii) Relation R in the set \mathbf{N} of natural numbers defined as $R = \{(x, y) : y = x + 5 \text{ and } x < 4\}$
- (iii) Relation R in the set $A = \{1, 2, 3, 4, 5, 6\}$ as $R = \{(x, y) : y \text{ is divisible by } x\}$
- (iv) Relation R in the set \mathbf{Z} of all integers defined as $R = \{(x, y) : x - y \text{ is an integer}\}$
- (v) Relation R in the set A of human beings in a town at a particular time given by
 - (a) $R = \{(x, y) : x \text{ and } y \text{ work at the same place}\}$
 - (b) $R = \{(x, y) : x \text{ and } y \text{ live in the same locality}\}$
 - (c) $R = \{(x, y) : x \text{ is exactly } 7 \text{ cm taller than } y\}$
 - (d) $R = \{(x, y) : x \text{ is wife of } y\}$
 - (e) $R = \{(x, y) : x \text{ is father of } y\}$

Answer 1:

(i) $A = \{1, 2, 3, \dots, 13, 14\}$

$R = \{(x, y) : 3x - y = 0\}$

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

R is not reflexive since $(1, 1), (2, 2), \dots, (14, 14) \notin R$.

Also, R is not symmetric as $(1, 3) \in R$, but $(3, 1) \notin R$. [$3(3) - 1 \neq 0$]

Also, R is not transitive as $(1, 3), (3, 9) \in R$, but $(1, 9) \notin R$. [$3(1) - 9 \neq 0$] Hence, R is neither reflexive, nor symmetric, nor transitive.

(ii) $R = \{(x, y) : y = x + 5 \text{ and } x < 4\} = \{(1, 6), (2, 7), (3, 8)\}$

It is clear that $(1, 1) \notin R$.

$\therefore R$ is not reflexive.

$(1, 6) \in R$ But, $(6, 1) \notin R$.

$\therefore R$ is not symmetric.

Now, since there is no pair in R such that (x, y) and $(y, z) \in R$, then (x, z) cannot belong to R .

$\therefore R$ is not transitive.

Hence, R is neither reflexive, nor symmetric, nor transitive.

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

$R = \{(x, y) : y \text{ is divisible by } x\}$

We know that any number (x) is divisible by itself.

So, $(x, x) \in R$

$\therefore R$ is reflexive.

Now, $(2, 4) \in R$

[as 4 is divisible by 2]

But, $(4, 2) \notin R$.

[as 2 is not divisible by 4]

$\therefore R$ is not symmetric.

Let $(x, y), (y, z) \in R$. Then, y is divisible by x and z is divisible by y .

$\therefore z$ is divisible by x .

$\Rightarrow (x, z) \in R$

$\therefore R$ is transitive.

Hence, R is reflexive and transitive but not symmetric.

(iv) $R = \{(x, y) : x - y \text{ is an integer}\}$

Now, for every $x \in \mathbf{Z}$, $(x, x) \in R$ as $x - x = 0$ is an integer.

$\therefore R$ is reflexive.

Now, for every $x, y \in \mathbf{Z}$, if $(x, y) \in R$, then $x - y$ is an integer.

$\Rightarrow -(x - y)$ is also an integer.

$\Rightarrow (y - x)$ is an integer.

$\therefore (y, x) \in R$

$\therefore R$ is symmetric.

Now, let (x, y) and $(y, z) \in R$, where $x, y, z \in \mathbf{Z}$.

$\Rightarrow (x - y)$ and $(y - z)$ are integers.

$\Rightarrow x - z = (x - y) + (y - z)$ is an integer.

$\therefore (x, z) \in R$

$\therefore R$ is transitive.

Hence, R is reflexive, symmetric, and transitive.

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