

# 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  $N$  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  $Z$  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,  $(1, 6) \notin R$ .

$\therefore R$  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  $x \in Z$ ,  $(x, x) \in R$  as  $x - x = 0$  is an integer.

$\therefore R$  is reflexive.

Now, for every  $x, y \in Z$ , 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  $x, y, z \in Z$ .

$\Rightarrow (x - y)$  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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**Yan Bai**



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