

Exercise 1.1

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

Sol.

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

Relation R in the set A is defined as

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

$$\text{i.e., } R = \{(x, y) : -y = -3x \text{ i.e., } y = 3x\} \quad \dots(i)$$

Is R reflexive? Let $x \in A$. Putting $y = x$ in (i), $x = 3x$
 Dividing by $x \neq 0$ ($x \in A$ here is $\neq 0$), $1 = 3$ which is impossible. Therefore $(x, x) \notin R$ and hence R is not reflexive.

Is R symmetric? Let $(x, y) \in R$, therefore by (i) $y = 3x$

Interchanging x and y in (i), $x = 3y$ which is not true

$$\therefore y = 3x \Rightarrow x = \frac{y}{3} \text{ and } \neq 3y$$

For example, $2 \in A$, $6 \in A$ and $6 = 3(2)$ (i.e., $y = 3x$)
 but $2 \neq 3(6) = 18$.

$\therefore (2, 6) \in R$ but $(6, 2) \notin R \quad \therefore R$ is not symmetric.

Is R transitive? Let $(x, y) \in R$ and $(y, z) \in R$.

Therefore by (i), $y = 3x$ and $z = 3y$.

To eliminate y , Putting $y = 3x$ in $z = 3y$, $z = 3(3x) = 9x$

\therefore By (i), $(x, z) \notin R$.

$\therefore R$ is not transitive.

- (ii) **Given:** Relation R in the set of natural numbers defined as

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