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... 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 and x < 4}
(iii) Relation R in the set A = {1, 2, 3, 4, 5, 6} as R = {(x, y): y is divisible by x}
(iv) Relation R in the set Z of all integers defined as R = {(x, y): x – y 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 and y work at the same place}
(b) R = {(x, y): x and y live in the same locality}
(c) R = {(x, y): x is exactly 7 cm taller than y}
(d) R = {(x, y): x is wife of y}
(e) R = {(x, y): x is father of y}

Answer 1:

(i) A = {1, 2, 3 ... 13, 14}
R = {(x, y): 3x – y = 0}
∴ R = {(1, 3), (2, 6), (3, 9), (4, 12)}
R is not reflexive since (1, 1), (2, 2) ... (14, 14) ∉ R.
Also, R is not symmetric as (1, 3) ∈ R, but (3, 1) ∉ R. [3(3) – 1 ≠ 0]
Also, R is not transitive as (1, 3), (3, 9) ∈ R, but (1, 9) ∉ R. [3(1) – 9 ≠ 0] Hence, R is neither reflexive, nor symmetric, nor transitive.
(ii) R = {(x, y): y = x + 5 and x < 4} = {(1, 6), (2, 7), (3, 8)}
It is clear that (1, 1) ∉ R.
∴ R is not reflexive.
(1, 6) ∈ R But, (1, 6) ∉ R.
∴ R is not symmetric.
Now, since there is no pair in R such that (x, y) and (y, z) ∈ R, then (x, z) cannot belong to R.
∴ 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 is divisible by x}
We know that any number (x) is divisible by itself.
So, (x, x) ∈ R
∴ R is reflexive.
Now, (2, 4) ∈ R [as 4 is divisible by 2]
But, (4, 2) ∉ R. [as 2 is not divisible by 4]
∴ R is not symmetric.
Let (x, y), (y, z) ∈ R. Then, y is divisible by x and z is divisible by y.
∴ z is divisible by x.
⇒ (x, z) ∈ R
∴ R is transitive.
Hence, R is reflexive and transitive but not symmetric.
(iv) R = {(x, y): x – y is an integer}
Now, for every x ∈ Z, (x, x) ∈ R as x – x = 0 is an integer.
∴ R is reflexive.
Now, for every x, y ∈ Z, if (x, y) ∈ R, then x – y is an integer.
⇒ –(x – y) is also an integer.
⇒ (y – x) is an integer.
∴ (y, x) ∈ R
∴ R is symmetric.
Now, let (x, y) and (y, z) ∈ R, where x, y, z ∈ Z.
⇒ (x – y) and (y – z) are integers.
⇒ x – z = (x – y) + (y – z) is an integer.
∴ (x, z) ∈ R
∴ R is transitive.
Hence, R is reflexive, symmetric, and transitive.

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