

## EXERCISE 5.5

**Q.1** If  $L = \{a, b, c\}$ ,  $M = \{3, 4\}$ , then find two binary relations of  $L \times M$  and  $M \times L$ .

**Solution:**  $L = \{a, b, c\}$ ,  $M = \{3, 4\}$

$$L \times M = \{a, b, c\} \times \{3, 4\}$$

$$= \{(a, 3), (a, 4), (b, 3), (b, 4), (c, 3), (c, 4)\}$$

**Two binary Relations:**

$$R_1 = \{(a, 3), (a, 4)\}$$

$$R_2 = \{(b, 4), (c, 3), (c, 4)\}$$

$$M \times L = \{3, 4\} \times \{a, b, c\}$$

$$= \{(3, a), (3, b), (3, c), (4, a), (4, b), (4, c)\}$$

**Two binary Relations:**

$$R_1 = \{(3, a), (3, b)\}$$

$$R_2 = \{(4, b), (4, c)\}$$

**Q.2** If  $Y = \{-2, 1, 2\}$ , then make two binary relations for  $Y \times Y$ . Also find their domain and range.

**Solution:**  $Y = \{-2, 1, 2\}$

$$Y \times Y = \{-2, 1, 2\} \times \{-2, 1, 2\}$$

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

$$R_1 = \{(-2, 1), (-2, 2), (1, -2)\}$$

$$\text{Domain } R_1 = \{-2, 1\}$$

$$\text{Range } R_1 = \{1, 2, -2\}$$

$$R_2 = \{(1, 1), (2, -2), (2, 2)\}$$

$$\text{Domain } R_2 = \{1, 2\}$$

$$\text{Range } R_2 = \{1, -2, 2\}$$

**Q.3** If  $L = \{a, b, c\}$  and  $M = \{d, e, f, g\}$ , then find two binary relations in each.

(i)  $L \times L$  (ii)  $L \times M$  (iii)  $M \times M$

**Solution:**  $L = \{a, b, c\}$ ,  $M = \{d, e, f, g\}$

$$(i) L \times L = \{a, b, c\} \times \{a, b, c\}$$

$$L \times L = \{(a,a), (a,b), (a,c), (b,a), (b,b), (b,c), \\ (c,a), (c,b), (c,c)\}$$

**Two binary Relations:**

$$R_1 = \{(a, a), (a, b), (a, c)\}$$

$$R_2 = \{(b, c), (c, a), (c, b)\}$$

**(ii)  $L \times M$**

$$L \times M = \{a, b, c\} \times \{d, e, f, g\} \\ = \{(a,d), (a,e), (a,f), (a,g), (b,d), (b,e), (b,f), \\ (b,g), (c, d), (c, e), (c, f), (c, g)\}$$

**Two binary Relations:**

$$R_1 = \{(a, d), (a, e), (a, f)\}$$

$$R_2 = \{(b, d), (b, e), (b, f)\}$$

**(iii)  $M \times M$**

$$M \times M = \{d, e, f, g\} \times \{d, e, f, g\} \\ = \{(d,d), (d,e), (d,f), (d,g), (e,d), (e,e), (e,f), (e,g), \\ (f,d), (f,e), (f,f), (f,g), (g,d), (g,e), (g,f), (g,g)\}$$

**Two binary Relations:**

$$R_1 = \{(d, e), (d, f), (d, g)\}$$

$$R_2 = \{(f, d), (g, d)\}$$

**Q.4 If set M has 5 elements then find the number of binary relations in M.**

$$\text{No. of binary relations in } M = 2^{5 \times 5} = 2^{25}$$

**Q.5 If  $L = \{x | x \in \mathbb{N} \wedge x \leq 5\}$ ,**

**$M = \{y | y \in \mathbb{P} \wedge y < 10\}$ , then make the following relations from L to M. Also write Domain and Range of each Relation.**

$$(i) R_1 = \{(x, y) | y < x\},$$

$$(ii) R_2 = \{(x, y) | y = x\}$$

$$(iii) R_3 = \{(x, y) | x + y = 6\}$$

$$(iv) R_4 = \{(x, y) | y - x = 2\}$$

**Solution**

$$L = \{1, 2, 3, 4, 5\},$$

$$M = \{2, 3, 5, 7\}$$

$$L \times M = \{1, 2, 3, 4, 5\} \times \{2, 3, 5, 7\}$$

$$= \{(1,2), (1,3), (1,5), (1,7), (2,2), (2,3), (2,5), \\ (2,7), (3,2), (3,3), (3,5), (3,7), (4,2), (4,3), (4,5), \\ (4,7), (5,2), (5,3), (5,5), (5,7)\}$$

**(i)  $R_1 = \{(x, y) | y < x\}$**

$$R_1 = \{(3, 2), (4, 2), (4, 3), (5, 2), (5, 3)\}$$

$$\text{Domain } R_1 = \{3, 4, 5\}$$

$$\text{Range } R_1 = \{2, 3\}$$

**(ii)  $R_2 = \{(x, y) | y = x\}$**

$$R_2 = \{(2, 2), (3, 3), (5, 5)\}$$

$$\text{Domain } R_2 = \{2, 3, 5\}$$

$$\text{Range } R_2 = \{2, 3, 5\}$$

**(iii)  $R_3 = \{(x, y) | x + y = 6\}$**

$$R_3 = \{(1, 5), (3, 3), (4, 2)\}$$

$$\text{Domain } R_3 = \{1, 3, 4\}$$

$$\text{Range } R_3 = \{5, 3, 2\}$$

**(iv)  $R_4 = \{(x, y) | y - x = 2\}$**

$$R_4 = \{(1, 3), (3, 5), (5, 7)\}$$

$$\text{Domain } R_4 = \{1, 3, 5\}$$

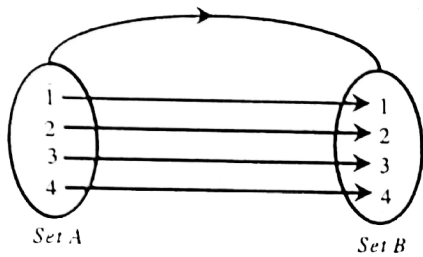
$$\text{Range } R_4 = \{3, 5, 7\}$$

**Q.6 Indicate relations, into function, one-one function, onto function, and bijective function from the following. Also find their domain and the range.**

$$R_1 = \{(1, 1), (2, 2), (3, 3), (4, 4)\}$$

$$\text{Domain } R_1 = \{1, 2, 3, 4\}$$

$$\text{Range } R_1 = \{1, 2, 3, 4\}$$

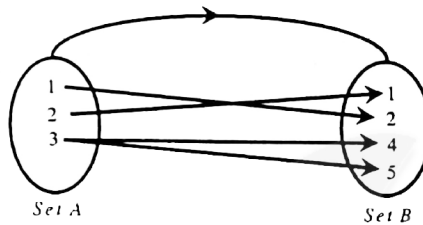


It is a bijective function.

(ii)  $R_2 = \{(1, 2), (2, 1), (3, 4), (3, 5)\}$

Domain  $R_2 = \{1, 2, 3\}$

Range  $R_2 = \{1, 2, 4, 5\}$

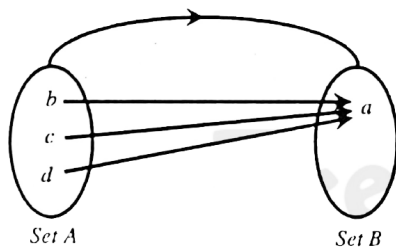


It is a relation. As 3 has no distinct image.

(iii)  $R_3 = \{(b, a), (c, a), (d, a)\}$

Domain  $R_3 = \{b, c, d\}$

Range  $R_3 = \{a\}$

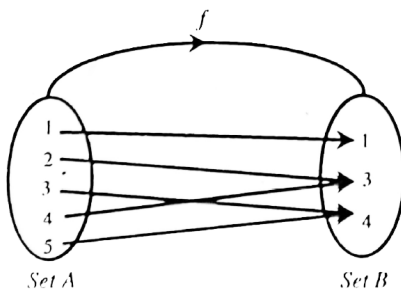


It is an onto function.

(iv)  $R_4 = \{(1, 1), (2, 3), (3, 4), (4, 3), (5, 4)\}$

Domain  $R_4 = \{1, 2, 3, 4, 5\}$

Range  $R_4 = \{1, 3, 4\}$



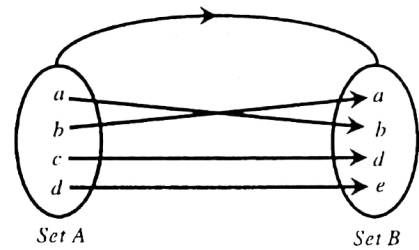
It is an onto function.

(v)  $R_5 = \{(a, b), (b, a), (c, d), (d, e)\}$

Domain  $R_5 = \{a, b, c, d\}$

Range  $R_5 = \{a, b, d, e\}$

It is a bijective function.

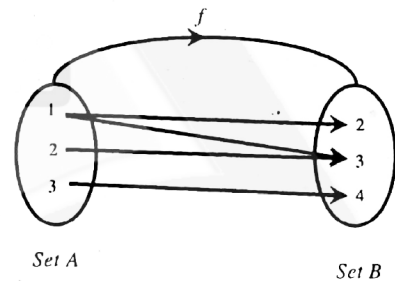


(vi)  $R_6 = \{(1, 2), (2, 3), (1, 3), (3, 4)\}$

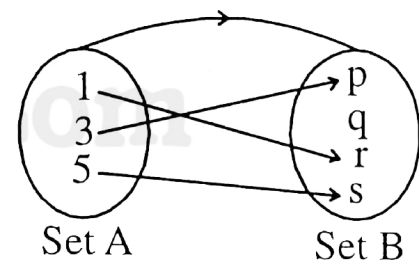
Domain  $R_6 = \{1, 2, 3\}$

Range  $R_6 = \{2, 3, 4\}$

It is a relation. As 1 has no distinct image.



(vii)  $R_7 =$

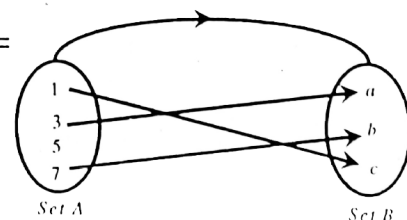


Domain  $R_7 = \{1, 3, 5\}$

Range  $R_7 = \{p, r, s\}$

$R_7$  is one-one function.

(viii)  $R_8 =$



Domain  $R_8 = \{1, 3, 7\}$

Range  $R_8 = \{a, b, c\}$

It is a relation. As 5 has no distinct image.