

Test / Exam Name: 2 Relations And Functions Standard: 11th Science Subject: Mathematics  
Q

Instructions

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**Q1.** Find the domain and range of the following real functions: **2 Mark**  
 $f(x) = \sqrt{9 - x^2}$ .

**Ans:**

Since  $\sqrt{9 - x^2}$  is defined for all real numbers that are greater than or equal to -3 and less than or equal to 3, the domain of  $f(x)$  is  $\{x : -3 \leq x \leq 3\}$  or  $[-3, 3]$ .  
For any value of  $x$  such that  $-3 \leq x \leq 3$ , the value of  $f(x)$  will lie between 0 and 3.  
 $\therefore$  The range of  $f(x)$  is  $\{x : 0 \leq x \leq 3\}$  or  $[0, 3]$ .

**Q2.** Let  $A = \{12, 13, 14, 15, 16, 17\}$  and  $f : A \rightarrow Z$  be a function given by  $f(x) =$  highest prime factor of  $x$ . Find range of  $f$ . **2 Mark**

**Ans:**

We have,  
 $f(x) =$  highest prime factor of  $X$ .  
 $\therefore 12 = 3 \times 4$ ,  
 $13 = 13 \times 1$ ,  
 $14 = 7 \times 2$ ,  
 $15 = 5 \times 3$ ,  
 $16 = 2 \times 8$ ,  
 $17 = 17 \times 1$   
 $\therefore f = \{(12, 3), (13, 13), (14, 7), (15, 5), (16, 2), (17, 17)\}$   
 $\therefore \text{Range}(f) = \{3, 13, 7, 5, 2, 17\}$

**Q3.** In following case, find  $a$  and  $b$ . **2 Mark**  
 $\left(\frac{a}{4}, a - 2b\right) = (0, 6 + b)$

**Ans:**

$\left(\frac{a}{4}, a - 2b\right) = (0, 6 + b)$   
 $\Rightarrow \frac{a}{4} = 0 \Rightarrow a = 0$   
and  $a - 2b = 6 + b$   
 $\Rightarrow 0 - 2b = 6 + b$   
 $\Rightarrow b = -2$   
 $\therefore a = 0, b = -2$

**Q4.** Find the domain of following function given by: **2 Mark**  
 $f(x) = \frac{x^3 - x + 3}{x^2 - 1}$

**Ans:**

We have,  $f(x) = \frac{x^3 - x + 3}{x^2 - 1}$   
 $f(x)$  is not defined, if  $x^2 - 1 = 0$   
 $\Rightarrow (x - 1)(x + 1) = 0$   
 $\Rightarrow x = -1, 1$   
 $\therefore \text{Domain of } f = R - \{-1, 1\}$

**Q5.**  $A = \{1, 2, 3, 5\}$  and  $B = \{4, 6, 9\}$ . Define a relation  $R$  from  $A$  to  $B$  by  $R = \{(x, y) : \text{the difference between } x \text{ and } y \text{ is odd}; x \in A, y \in B\}$ . Write  $R$  in roster form. **2 Mark**

**Ans:**

$A = \{1, 2, 3, 5\}$  and  $B = \{4, 6, 9\}$

$R = \{(x, y) : \text{the difference between } x \text{ and } y \text{ is odd}; x \in A, y \in B\}$

Therefore,  $R = \{(1, 4), (1, 6), (2, 9), (3, 4), (3, 6), (5, 4), (5, 6)\}$

**Q6.** If  $R_1 = \{(x, y) \mid y = 2x + 7, \text{ where } x \in \mathbb{R} \text{ and } -5 \leq x \leq 5\}$  is a relation. Then find the domain and Range of  $R_1$ . **2 Mark**

**Ans:**

We have,  $R_1 = \{(x, y) \mid y = 2x + 7, \text{ where } x \in \mathbb{R} \text{ and } -5 \leq x \leq 5\}$

Domain of  $R_1 = \{-5 \leq x \leq 5, x \in \mathbb{R}\} = [-5, 5]$

$x \in [-5, 5]$

$\Rightarrow 2x \in [-10, 10]$

$\Rightarrow 2x + 7 \in [-3, 17]$

Range is  $[-3, 17]$

**Q7.** If  $A = \{1, 2, 3\}$ ,  $B = \{4, 5, 6\}$ , the given following are relations from  $A$  to  $B$ ? Give reason in support of your answer. **2 Mark**  
 $A \times B$ .

**Ans:**

We have,

$A = \{1, 2, 3\}$  and  $B = \{4, 5, 6\}$

$A \times B$ , is a relation from  $A$  to  $B$ .

**Q8.** If  $A = \{x : x \in \mathbb{W}, x \in 2\}$ ,  $B = \{x : x \in \mathbb{N}, 1 < x < 5\}$ ,  $C = \{3, 5\}$  find. **3 Mark**  
1.  $A \times (B \cap C)$   
2.  $A \times (B \cup C)$

**Ans:**

Given that:

$A = \{x : x \in \mathbb{W}, x \in 2\} \Rightarrow A = \{0, 1\}$

$B = \{x : x \in \mathbb{N}, 1 < x < 5\} \Rightarrow B = \{2, 3, 4\}$

$C = \{3, 5\}$

Now  $(B \cap C) = \{3\}$  and  $(B \cup C) = \{2, 3, 4, 5\}$

1.  $A \times (B \cap C) = \{0, 1\} \times \{3\} = \{(0, 3), (1, 3)\}$

2.  $A \times (B \cup C) = \{0, 1\} \times \{2, 3, 4, 5\}$   
 $= \{(0, 2), (0, 3), (0, 4), (0, 5), (1, 2), (1, 3), (1, 4), (1, 5)\}$

**Q9.** Determine the domain and range of the relation  $R$  defined by  $R = \{(x, x + 5) : x \in \{0, 1, 2, 3, 4, 5\}\}$ . **3 Mark**

**Ans:**

$R = \{(x, x + 5) : x \in \{0, 1, 2, 3, 4, 5\}\}$

$R = \{(0, 5), (1, 6), (2, 7), (3, 8), (4, 9), (5, 10)\}$

Domain of  $R = \{0, 1, 2, 3, 4, 5\}$

Range of  $R = \{5, 6, 7, 8, 9, 10\}$

**Q10.** Determine the domain and range of the relation  $R$  defined by: **3 Mark**  
 $R = \{(x, x^3) : x \text{ is a prime number less than } 10\}$

**Ans:**

We have,

$R = \{(x, x^3): x \text{ is a prime number less than } 10\}$

For the elements of the given sets, we find that

$x = 2, 3, 5, 7$

$\therefore (2, 8) \in R, (3, 27) \in R, (5, 125) \in R \text{ and } (7, 343) \in R$

$\Rightarrow R = \{(2, 8), (3, 27), (5, 125), (7, 343)\}$

Clearly, Domain (R) =  $\{2, 3, 5, 7\}$  and Range (R) =  $\{8, 27, 125, 343\}$

**Q11.** Given  $A = \{1, 2, 3\}$ ,  $B = \{3, 4\}$ ,  $C = \{4, 5, 6\}$ , find  $(A \times B) \cap (B \times C)$

**3 Mark**

**Ans:**

We have,

$A = \{1, 2, 3\}$ ,  $B = \{3, 4\}$  and  $C = \{4, 5, 6\}$

$\therefore A \times B = \{1, 2, 3\} \times \{3, 4\}$

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

and  $B \times C = \{3, 4\} \times \{4, 5, 6\}$

$= \{(3, 4), (3, 5), (3, 6), (4, 4), (4, 5), (4, 6)\}$

$\therefore (A \times B) \cap (B \times C) = \{(3, 4)\}$

**Q12.** Let  $A = \{1, 2, 3, 4, 6\}$ . Let R be the relation on A defined by  $\{(a, b): a, b \in A, b \text{ is exactly divisible by } a\}$ . **3 Mark**

1. Write R in roster form.

2. Find the domain of R.

3. Find the range of R.

**Ans:**

$A = \{1, 2, 3, 4, 6\}$ ,  $R = \{(a, b): a, b \in A, b \text{ is exactly divisible by } a\}$

1.  $R = \{(1, 1), (1, 2), (1, 3), (1, 4), (1, 6), (2, 2), (2, 4), (2, 6), (3, 3), (3, 6), (4, 4), (6, 6)\}$

2. Domain of  $R = \{1, 2, 3, 4, 6\}$

3. Range of  $R = \{1, 2, 3, 4, 6\}$

**Q13.** If  $A = \{1, 2, 3\}$ ,  $B = \{3, 4\}$  and  $C = \{4, 5, 6\}$ , find  $(A \times B) \cup (A \times C)$

**3 Mark**

**Ans:**

$(A \times B) \cup (A \times C)$

Now,

$(A \times B) = \{(1, 3), (1, 4), (2, 3), (2, 4), (3, 3), (3, 4)\}$

And,

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

$\therefore (A \times B) \cup (A \times C)$

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

**Q14.** If  $f(x) = x^3 - \frac{1}{x^3}$ , show that  $f(x) + f\left(\frac{1}{x}\right) = 0$

**3 Mark**

**Ans:**

We have,

$f(x) = x^3 - \frac{1}{x^3} \dots (i)$

Now,  $f\left(\frac{1}{x}\right) = \left(\frac{1}{x}\right)^3 - \frac{1}{\left(\frac{1}{x}\right)^3}$

$= \frac{1}{x^3} - \frac{1}{\frac{1}{x^3}}$

$f\left(\frac{1}{x}\right) = \frac{1}{x^3} - x^3 \dots (ii)$

Adding equation (i) and equation (ii), we get

$f(x) + f\left(\frac{1}{x}\right) = \left(x^3 - \frac{1}{x^3}\right) + \left(\frac{1}{x^3} - x^3\right)$

$$= x^3 - \frac{1}{x^3} + \frac{1}{x^3} - x^3$$

$$= 0$$

$$\therefore f(x) + f\left(\frac{1}{x}\right) = 0 \text{ Hence, proved.}$$

**Q15.** Let  $A = \{1, 2\}$ ,  $B = \{1, 2, 3, 4\}$ ,  $C = \{5, 6\}$  and  $D = \{5, 6, 7, 8\}$ . Verify that:  
 $A \times C \subset B \times D$

**5 Mark**

**Ans:**

We have,

$$A = \{1, 2\}, B = \{1, 2, 3, 4\}, C = \{5, 6\} \text{ and } D = \{5, 6, 7, 8\}$$

$$\therefore B \times D = \{1, 2, 3, 4\} \times \{5, 6, 7, 8\}$$

$$\{(1, 5), (1, 6), (1, 7), (1, 8), (2, 5), (2, 6), (2, 7), (2, 8), (3, 5), (3, 6), (3, 7), (3, 8), (4, 5), (4, 6), (4, 7), (4, 8)\} \dots (i)$$

$$\text{and, } A \times C = \{1, 2\} \times \{5, 6\}$$

$$= \{(1, 5), (1, 6), (2, 5), (2, 6)\} \dots (ii)$$

Clearly from equation (i) and equation (ii), we get

$$A \times C \subset B \times D$$

Hence verified.

**Q16.** Prove that:

**5 Mark**

$$(A \cup B) \times C = (A \times C) \cup (B \times C)$$

**Ans:**

Let  $(a, b)$  be an arbitrary element of  $(A \cup B) \times C$ . Then,

$$(a, b) \in (A \cup B) \times C$$

$$\Rightarrow a \in A \cup B \text{ and } b \in C \text{ [By definition]}$$

$$\Rightarrow (a \in A \text{ or } a \in B) \text{ and } b \in C \text{ [By definition]}$$

$$\Rightarrow (a \in A \text{ and } b \in C) \text{ or } (a \in B \text{ and } b \in C)$$

$$\Rightarrow (a, b) \in A \times C \text{ or } (a, b) \in B \times C$$

$$\Rightarrow (a, b) \in (A \times C) \cup (B \times C)$$

$$\Rightarrow (a, b) \in (A \cup B) \times C$$

$$\Rightarrow (a, b) \in (A \times C) \cup (B \times C)$$

$$\Rightarrow (A \cup B) \times C \subseteq (A \times C) \cup (B \times C) \dots (i)$$

Again, let  $(x, y)$  be an arbitrary element of  $(A \times C) \cup (B \times C)$ . Then,

$$(x, y) \in (A \times C) \cup (B \times C)$$

$$\Rightarrow (x, y) \in A \times C \text{ or } (x, y) \in B \times C$$

$$\Rightarrow x \in A \text{ and } y \in C \text{ or } x \in B \text{ and } y \in C$$

$$\Rightarrow (x \in A \text{ or } x \in B) \text{ and } y \in C$$

$$\Rightarrow x \in A \cup B \text{ and } y \in C$$

$$\Rightarrow (x, y) \in (A \cup B) \times C$$

$$\Rightarrow (x, y) \in (A \times C) \cup (B \times C)$$

$$\Rightarrow (x, y) \in (A \cup B) \times C$$

$$\Rightarrow (A \times C) \cup (B \times C) \subseteq (A \cup B) \times C \dots (ii)$$

Using equation (i) and equation (ii), we get

$$(A \cup B) \times C = (A \times C) \cup (B \times C)$$

Hence proved.

**Q17.** If  $A = \{1, 2, 3\}$ ,  $B = \{4\}$ ,  $C = \{5\}$ , then verify that:

**5 Mark**

$$A \times (B - C) = (A \times B) - (A \times C)$$

**Ans:**

We have,

$$A = \{1, 2, 3\}, B = \{4\} \text{ and } C = \{5\}$$

$$\therefore B - C = \{4\}$$

$$\therefore A \times (B - C) = \{1, 2, 3\} \times \{4\}$$

$$\Rightarrow A \times (B - C) = \{(1, 4), (2, 4), (3, 4)\} \dots (i)$$

Now,

$$A \times B = \{1, 2, 3\} \times \{4\}$$

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

$$\text{and, } A \times C = \{1, 2, 3\} \times \{5\}$$

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

$$\therefore (A \times B) - (A \times C) = \{(1, 4), (2, 4), (3, 4)\} \dots (ii)$$

From equation (i) and (ii), we get

$$A \times (B - C) = (A \times B) - (A \times C)$$

Hence verified.

**Q18.** Prove that:

**5 Mark**

$$(A \cap B) \times C = (A \times C) \cap (B \times C)$$

**Ans:**

Let  $(a, b)$  be an arbitrary element of  $(A \cap B) \times C$ . Then,

$$(a, b) \in (A \cap B) \times C$$

$$\Rightarrow a \in A \cap B \text{ and } b \in C$$

$$\Rightarrow (a \in A \text{ or } a \in B) \text{ and } b \in C \text{ [By definition]}$$

$$\Rightarrow (a \in A \text{ and } b \in C) \text{ or } (a \in B \text{ and } b \in C)$$

$$\Rightarrow (a, b) \in A \times C \text{ and } (a, b) \in B \times C$$

$$\Rightarrow (a, b) \in (A \times C) \cap (B \times C)$$

$$\Rightarrow (a, b) \in (A \cap B) \times C$$

$$\Rightarrow (a, b) \in (A \times C) \cap (B \times C)$$

$$\Rightarrow (A \cap B) \times C \subseteq (A \times C) \cap (B \times C) \dots (i)$$

Let  $(x, y)$  be an arbitrary element of  $(A \times C) \cap (B \times C)$ . Then,

$$(x, y) \in (A \times C) \cap (B \times C)$$

$$\Rightarrow (x, y) \in A \times C \text{ and } (x, y) \in B \times C \text{ [By definition]}$$

$$\Rightarrow (x \in A \text{ and } y \in C) \text{ and } (x \in B \text{ and } y \in C)$$

$$\Rightarrow (x \in A \text{ or } x \in B) \text{ and } y \in C$$

$$\Rightarrow x \in A \cap B \text{ and } y \in C$$

$$\Rightarrow (x, y) \in (A \cap B) \times C$$

$$\Rightarrow (x, y) \in (A \times C) \cap (B \times C)$$

$$\Rightarrow (x, y) \in (A \cap B) \times C$$

$$\Rightarrow (A \times C) \cap (B \times C) \subseteq (A \cap B) \times C \dots (ii)$$

Using equation (i) and equation (ii), we get

$$(A \cap B) \times C = (A \times C) \cap (B \times C)$$

Hence proved.

**Q19.** If  $A = \{2, 3\}$ ,  $B = \{4, 5\}$ ,  $C = \{5, 6\}$ , find

**5 Mark**

$$A \times (B \cap C), A \times (B \cap C), (A \times B) \cup (A \times C).$$

**Ans:**

We have,

$$A = \{2, 3\}, B = \{4, 5\} \text{ and } C = \{5, 6\}$$

$$\therefore B \cup C = \{4, 5\} \cup \{5, 6\} = \{4, 5, 6\}$$

$$\therefore A \times \{B \cup C\} = \{2, 3\} \times \{4, 5, 6\}$$

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

Now,

$$B \cap C = \{4, 5\} \cap \{5, 6\} = \{5\}$$

$$\therefore A \times (B \cap C) = \{2, 3\} \times \{5\}$$

$$A \times (B \cap C) = \{(2, 5), (3, 5)\}$$

Now,

$$A \times B = \{2, 3\} \times \{4, 5\}$$

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

and  $A \times C = \{2, 3\} \times \{5, 6\}$   
 $= \{(2, 5), (2, 6), (3, 5), (3, 6)\}$   
 $\therefore (A \times B) \cup (A \times C) = \{(2, 4), (2, 5), (2, 6), (3, 4), (3, 5), (3, 6)\}$

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