



MATHS

NCERT - NCERT MATHEMATICS(HINGLISH)

RELATIONS AND FUNCTIONS

Exercise 2.2

1. $A = \{1, 2, 3, 5\}$ 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.

A.

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

B.

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

C.

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

D.

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

Answer: D



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2. Define a relation R on the set N of natural numbers by

$$R = \{(x, y) : y = x + 5, x \text{ is a natural number less than}$$

$4; x, y \in N\}$. Depict this relationship using roster form. Write

down the domain and the range...



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3. Let $A = \{1, 2, 3, \dots, 14\}$. Define a relation R from A to A by $R = \{(x, y) : 3x - y = 0, \text{ where } x, y \in A\}$. Write down its domain, co-domain and range.



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



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5. Let $A = \{1, 2, 3, 4, 6\}$. Let R be the relation on A defined by $\{(ab) : a, b \in A, b \text{ is exactly divisible by } a\}$. (i) Write R in roster form (ii) Find the domain of R (iii) Find the range of R .



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6. Let R be the relation on Z defined by $R = \{(a, b) : a, b \in Z, a - b \text{ is an integer}\}$. Find the domain and range of R .

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7. Let $A = \{x, y, z\}$ and $B = \{1, 2\}$. Find the number of relations from A to B .

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8. Write the Relation $R = \{(x, x^3) : x \text{ is a prime number less than } 10\}$ in roster form.

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9. The area bounded by the curves $y = \sqrt{x}$; $2y + 3 = x$ and $x -$ axis in the 4th quadrant is

A. if p“ $\frac{p}{r}$ and cos R. $\frac{p}{q}$ ”

B. null

C. null

D. null

Answer: null



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Exercise 2 1

1. The Cartesian product $A \times A$ has 9 elements among which are found $(-1, 0)$ and $(0, 1)$. Find the set A and the remaining elements of $A \times A$.

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2. If the set A has 3 elements and the set $B = \{3, 4, 5\}$, then find the number of elements in $(A \times B)$.

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3. If $G = \{7, 8\}$ and $H = \{5, 4, 2\}$, find $G \times H$ and $H \times G$.

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4. If $\left(\frac{x}{3} + 1, y - \frac{2}{3}\right) = \left(\frac{5}{3}, \frac{1}{3}\right)$, find the values of x and y .

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5. If $A \times B = \{(a, x), (a, y), (b, x), (b, y)\}$. Find A and B .

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6. Let $A = \{1, 2\}$, $B = \{1, 2, 3, 4\}$, $C = \{5, 6\}$ and $D = \{5, 6, 7, 8\}$. Verify that (i) $A \times (B \cap C) = (A \times B) \cap (A \times C)$. (ii) $A \times C$ is a subset of $B \times D$.

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7. State whether each of the following statements are true or false. If the statement is false, rewrite the given statement

correctly.(i)

If

$P = \{m, n\}$ and $Q = \{n, m\}$, then $P \times Q = \{(m, n), (n, m)\}$

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8. If $A = \{1, 1\}$, find $A \times A \times A$.



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9. Let $A = \{1, 2\}$ and $B = \{3, 4\}$. Write $A \times B$. How many subsets will $A \times B$ have? List them.



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10. Let A and B be two sets such that $n(A) = 3$ and $n(B) = 2$. If $(x, 1), (y, 2), (z, 1)$ are in $A \times B$. find A and B. where x, y and z are distinct elements.

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Solved Examples

1. 2 Let N be the set of natural numbers. Define a real valued function $f : N \rightarrow N$ by $f(x) = 2x + 1$. Using this definition, complete the table given below.

x	1	2	3	4	5	6	7
y	$f(1) = \dots$	$f(2) = \dots$	$f(3) = \dots$	$f(4) = \dots$	$f(5) = \dots$	$f(6) = \dots$	$f(7) = \dots$

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2. Examine each of the following relations given below and state in each case, giving reasons whether it is a function or not?

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

(ii) $R = \{(2,2), (2,4), (3,3), (4,4)\}$

(iii) $R = \{(1,2), (2,3), (3,4), (4,5), (5,6), (6,7)\}$

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3. Define the function $f : \mathbb{R} \rightarrow \mathbb{R}$ by $y = f(x) = x^2, x \in \mathbb{R}$. Complete the Table given below by using this definition. What is the domain and range of this function?

x	-4	-3	-2	-1	0	1	2	3	4
$y = f(x) = x^2$									

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4. Let N be the set of natural numbers and the relation R be defined on N such that $R = \{(x, y) : y = 2x, x, y \in N\}$. What is the domain, codomain and range of R ? Is this relation a function?

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5. Let $f(x) = \sqrt{x}$ and $g(x) = x$ be two functions defined over the set of nonnegative real numbers. Find $(f + g)(x)$, $(fg)(x)$, $(fg)(x)$ and $\left(\frac{f}{g}\right)(x)$.

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6. Let $f(x) = x^2$ and $g(x) = 2x + 1$ be two real functions. find $(f + g)(x)$, $(f - g)(x)$, $(fg)(x)$, $\left(\frac{f}{g}\right)(x)$.

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7. Define the real valued function $f: R \setminus \{0\} \rightarrow R$ defined by

$$f(x) = \frac{1}{x}, x \in R \setminus \{0\}.$$

Complete the Table given below using this definition. What is the domain and range of this function?
 $y = \frac{1}{x}$



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8. Draw the graph of the function $f: R \rightarrow R$ defined by

$$f(x) = x^3, x \in R.$$



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9. Let R be a relation from Q to Q defined by

$$R = \{(a, b) : a, b \in Q \text{ and } a, b \in Z\}.$$

Show that $\{a, a\} \in R$ for all a in Q , $\{a, b\} \in R \Rightarrow$ that

$$\{b, a\} \in R, \{a, b\} \in R \text{ and } \{b, c\} \in R \Rightarrow \{a, c\} \in R$$



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10. Let R be the set of real numbers. Define the real function $f: R \rightarrow R$ by $f(x) = x + 10$ and sketch the graph of this function.



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11. If $(x + 1, y - 2) = (3, -1)$, find the values of x and y .

A. 2, 1

B. 2, -1

C. -2, 1

D. None

Answer: A



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12. Let $A = \{1, 2, 3\}$, $B = \{3, 4\}$ and $C = \{4, 5, 6\}$. Find (i) $A \times (B \cap C)$ (ii) $(A \times B) \cap (A \times C)$ (iii) $A \times (B \cup C)$ (iv) $(A \times B) \cup (A \times C)$

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13. If $P = \{a, b, c\}$ and $A \times B = \{(p, q), (p, r), (m, q), (m, r)\}$ $Q = \{r\}$, form the sets $P \times Q$ and $Q \times P$. Are these two products equal?

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14. If R is the set of all real numbers, what do the cartesian products $R \times R$ and $R \times R \times R$ represent?

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15. If $P = \{1, 2\}$ form the set $P \times P \times P$.

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16. The function f is defined by $f(x) = \begin{cases} 1 - x & x < 0 \\ 1 & x = 0 \\ x + 1 & x > 0 \end{cases}$. Draw

the graph of $f(x)$.

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17. Find the domain of the function $f(x) = \frac{x^2 - 3x + 5}{x^2 - 5x + 4}$.

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18. Let $f = \{(1, 2), (2, 3), (0, -1), (-1, -3)\}$ be a linear function from Z into Z . Find $f(x)$.

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19. If $A \times B = \{(p, q), (p, r), (m, q), (m, r)\}$, find A and B .

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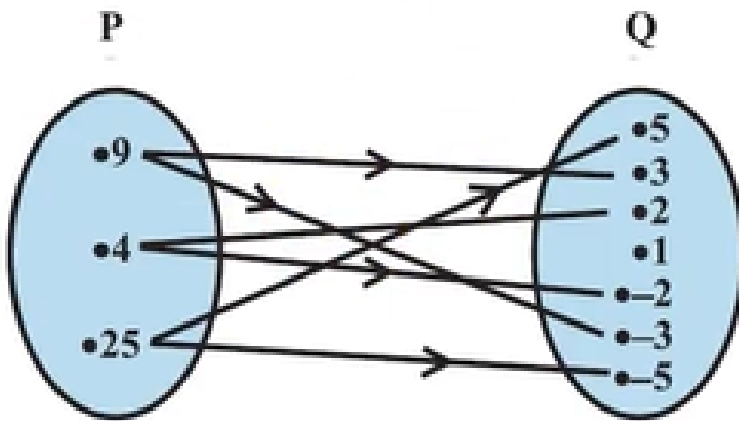
20. Let $A = \{1, 2, 3, 4, 5, 6\}$. Define a relation R from A to A by $R = \{(x, y) : y = x + 1\}$ (i) Depict this relation using an arrow diagram.(ii) Write down the domain, co-domain and range of R .

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21. The Fig 2.6 shows a relation between the sets P and Q. Write this relation

(i) in set-builder form,

(ii) in roster form. What is its domain and range?



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22. Let $A = \{1, 2\}$ and $B = \{3, 4\}$. Find the number of relations from A to B.

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Miscellaneous Exercise

1. Find the domain of the function $f(x) = \frac{x^2 + 2x + 1}{x^2 - 8x + 12}$

A. \mathbb{R}

B. $\mathbb{R} - \{4\}$

C. $\mathbb{R} - \{2,6\}$

D. $\mathbb{R} - \{2\}$

Answer: C



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2. The relation f is defined by

$f(x) = \{x^2, 0 \leq x \leq 3\}$ and $g(x) = \{3x, 3 \leq x \leq 10\}$ The relation g is defined

by $g(x) = \begin{cases} x^2, & 0 \leq x \leq 3 \\ 3x, & 2 \leq x \leq 10 \end{cases}$ Show that f is a function and g is not a function.

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3. If $f(x) = x^2$, find $\frac{f(1.1) - f(1)}{(1.1 - 1)}$

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4. Let $f = \{(1, 1), (2, 3), (0, 1), (1, 3)\}$ be a function from Z to Z defined by $f(x) = ax + b$, for some integers a, b . Determine a, b .

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5. Let R be a relation from N to N defined by $R = \{(a, b) : ab \in N \text{ and } a = b^2\}$. Are the following true? (i)

$(a, a) \in R, f$ or $\forall a \in N$ (ii) $(a, b) \in R, \text{ implies } (b, a) \in R$ (iii)

$\forall a,$



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6. Find the domain and the range of the real function f defined by

$$f(x) = \sqrt{(x - 1)}.$$



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7. Find the domain and the range of the real function/defined by

$$f(x) = |x - 1|$$



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8. Let $A = \{9, 10, 11, 12, 13\}$ and let $f: A \rightarrow \mathbb{N}$ be defined by $f(n)$ = the highest prime factor of n . Find the range of f .

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9. Let f be the subset of $\mathbb{Z} \times \mathbb{Z}$ defined by $f = \{(ab, a + b) : a, b \in \mathbb{Z}\}$. Is f a function from \mathbb{Z} to \mathbb{Z} ? Justify your answer.

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10. Let $A = \{1, 2, 3, 4\}$, $B = \{1, 5, 9, 11, 15, 16\}$ and $f = \{(1, 5), (2, 9), (3, 1), (4, 5), (2, 11)\}$. Are the following true?
(i) f is a relation from A to B (ii) f is a function from A to B . Justify y

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11. Let $f = \left\{ \left(x, \frac{x^2}{1+x^2} \right) : x \in R \right\}$ be a function from R into R .

Determine the range of f .

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12. Let $f, g: R \rightarrow R$ be defined, respectively by
 $f(x) = x + 1, g(x) = 2x - 3$. Find $f + g, fg$ and $\frac{f}{g}$.

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Exercise 2 3

1. Which of the following relations are functions? (i)

$\{(2, 1), (5, 1), (8, 1), (11, 1), (14, 1), (17, 1)\}$ (ii)

$\{(2, 1), (4, 2), (6, 3), (8, 4), (10, 5), (12, 6), (14, 7)\}$

A. i only

B. ii only

C. i and ii both

D. neither i nor ii

Answer: A

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2. Find the domain and range of the following real functions:(i)

$$f(x) = -|x| \text{ (ii) } f(x) = \sqrt{9 - x^2}$$

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3. A function f is defined by $f(x) = 2x - 5$. Write down the values of(i) $f(0)$, (ii) $f(7)$, (iii) $f(3)$.



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4. The function t which maps temperature in degree Celsius into temperature in degree Fahrenheit is defined by $t(C) = \frac{9C}{5} + 32$. Find (i) $t(0)$ (ii) $t(28)$ (iii) $t(-10)$ (iv) The value of C , when $t(C) = 212$.



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5. Find the range of each of the following functions.

(i) $f(x) = 2 - 3x, x \in \mathbb{R}, x > 0$

(ii) $f(x) = x^2 + 2, x$ is a real number.

(iii) $f(x) = x, x$ is a real number.



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