

MATHS

BOOKS - FULL MARKS MATHS (TAMIL ENGLISH)

RELATIONS AND FUNCTIONS

Progress Check

1. Let $A = \{1, 2, 3, 4\}$ and $B = \{a, b, c\}$

Which of the following are relations from A to B ?



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2. Relation are subsets of..... Funcitons are subsets of

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3. True or False : All the elements of a relation should have images.

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4. True of False : All the elements of a function should have images

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5. True or False : If $R: A \rightarrow B$ is a relation then the domain of $R = A$

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6. If $f : N \rightarrow N$ is defined as $f(x) = x^2$ the pre-image of 1 and 2 are

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7. What is the fundamental difference between an relation and a function? Is every relation a function?

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8. Let A and B be two non-empty finite sets, The which one among the following two collection is large?

(i) The number of relations between A and B

(ii) the number of function between A and B

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9. All one-one function are onto functions



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10. There will be no one-one function from A to B when

$$n(A) = 4, n(B) = 3$$



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11. All onto functions are one-one functions



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12. There will be no onto function from A to B when $n(A) = 4$, $n(B) = 5$



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13. If f is a bijection from A to B , then $n(A) = n(B)$



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14. If f is a bijection from A to B , then $n(A) = n(B)$



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15. All constant functions are bijections.



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16. Composition of functions is commutative :

- A. Always true
- B. Never true
- C. Sometimes true
- D.

Answer: A



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17. Composition of functions is associative :

- A. Always true
- B. Never true

C. Sometimes true

D.

Answer: A



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Exercise 1 1

1. Find $A \times B$, $A \times A$ and $B \times A$

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



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2. Let $A = \{1, 2, 3\}$ and $B = \{x \mid x \text{ is the prime number less than } 10\}$. Find $A \times B$ and $B \times A$.



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3. If $B \times A = \{(-2, 3), (-2, 4), (0, 3), (0, 4), (3, 3), (3, 4)\}$

find A and B



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4. If $A = (5,6), B = (4,5,6), C = (5,6,7)$, show that $A \times A = (B \times B) \cap (C \times C)$



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5.

Given

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

check $(A \cap C) \times (B \cap D) = (A \times B) \cap (C \times D)$ is true?

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6. By taking suitable sets A, B, C , verify the results :

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

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7. Let A = The set of all natural numbers less than 8, B =The set of all prime numbers less than 8, C = The set of even prime number.

Verify that

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

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Exercise 12

1. Let $A = \{1, 2, 3, 7\}$ and $B = \{3, 0, -1, 7\}$, which of the following are relation from A to B?

$$R_1 = \{(2, 1), (7, 1)\}$$

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2. Let $A = \{1, 2, 3, 4, \dots, 45\}$ and R be the relation defined as "is square of" on A. Write R as a subset of $A \times A$. Also, find the domain and range of R.

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3. A Relation R is given by the set $\{(x, y) \mid y = x + 3, x \in \{0, 1, 2, 4, 5\}\}$. Determine its domain and range.

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4. Represent each of the given relation by (a) an arrow diagram, (b) a graph and (C) a set in roster form, wherever possible.

$$\{(x, y) \mid x = 2y, x \in \{2, 3, 4, 5\}, y \in \{1, 2, 3, 4\}\}.$$



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5. A company has four categories of employees given by Assistants (A), Clerks(C), Managers (M) and an Executive Officer(E). The company provide ₹10,000, ₹25,000, ₹50,000 and ₹1,00,000 as salaries to the people who work in the categories A, C, M and E respectively. If A_1, A_2, A_3, A_4 and A_5 were Assistants, C_1, C_2, C_3, C_4 were Clerks, M_1, M_2 and M_3 were managers and E_1, E_2 were Executive officers and if the relation R is defined by xRy , where x is the salary given to person y,

express the relation R through an ordered pair and an arrow diagram/



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Exercise 13

1. Let $f = \{(x, y) \mid x, y \in \mathbb{N} \text{ and } y = 2x\}$ be a relation on \mathbb{N} . Find the domain, co-domain and range. Is this relation a function?



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2. Let $X = \{3, 4, 6, 8\}$. Determine whether the relation $R = \{x, f(x) \mid x \in X, f(x) = x^2 + 1\}$ is the function from X to \mathbb{N} ?



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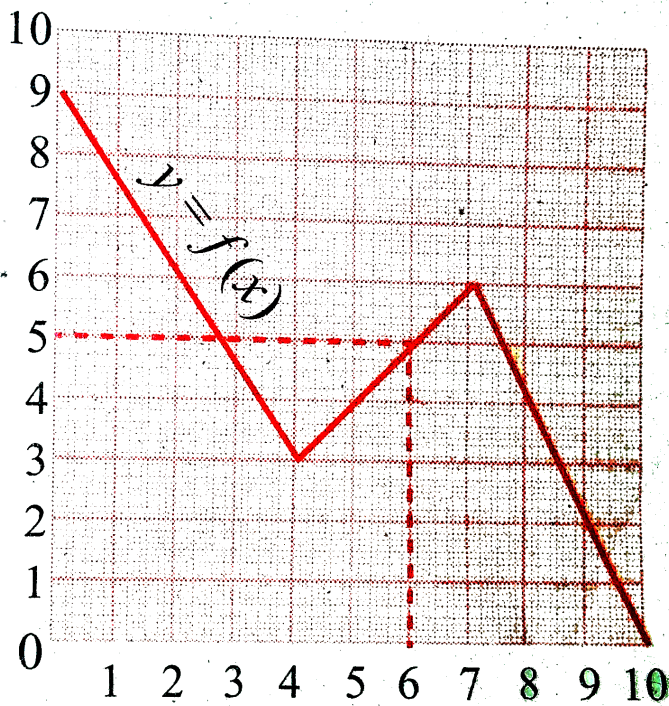
3. Given the function $f: x \rightarrow x^2 - 5x + 6$, evaluate

$f(-1)$



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4. A graph representing the function $f(x)$ is given in figure it is clear that $f(9) = 2$.



Find the following values of the function (a) $f(0)$ (b) $f(7)$ (c) $f(2)$
 (d) $f(10)$

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5. Let $f(x) = 2x + 5$. If $x \neq 0$ then find

$$\frac{f(x + 2) - f(2)}{x}$$

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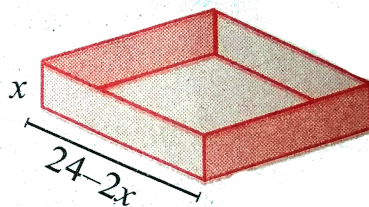
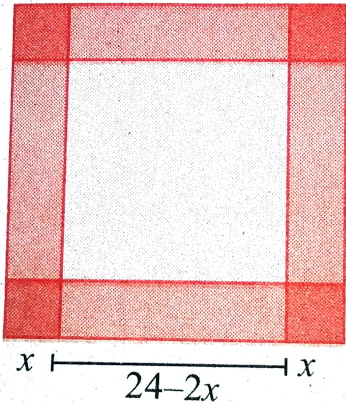
6. A function is defined by $f(x) = 2x - 3$

Find $\frac{f(0) + f(1)}{2}$.



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7. An open box is to be made from a square piece of material, 24 cm on a side, by cutting equal squares from the corners and turning up the sides as shown in figure. Express volume V of the box as a function of x .



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8. A function f is defined by $f(x) = 3 - 2x$. Find x such that $f(x^2) = (f(x))^2$.



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9. a plane is flying at a speed of 500 km per hour. Express the distance d travelled by the plane as function of time t in hours.



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10. The data in the adjacent table depicts the length of a woman's foreheads and her corresponding height. Based on this data, a student finds a relationship between the height (y) and the forehead length (x) as $y = ax + b$, where a, b are constants.

Length 'x' of forehand (in cm)	Height 'y' (in inches)
35	56
45	65
50	69.5
55	74

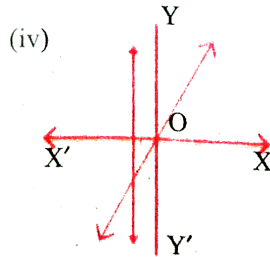
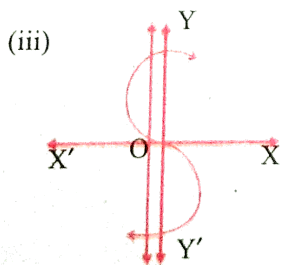
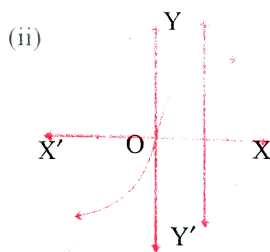
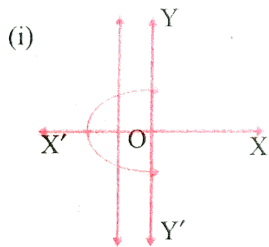
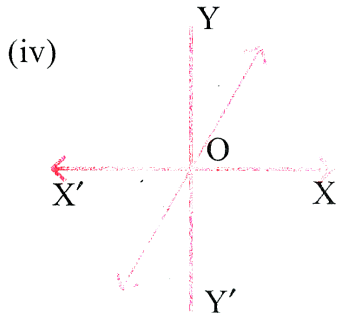
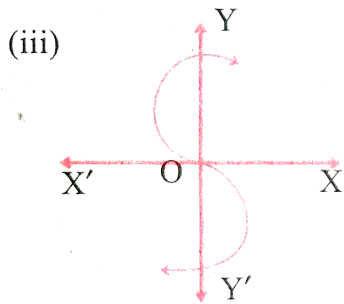
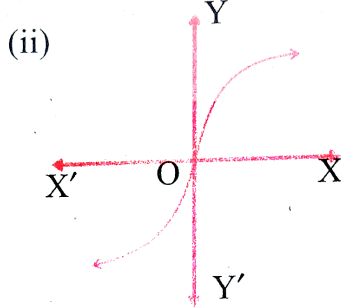
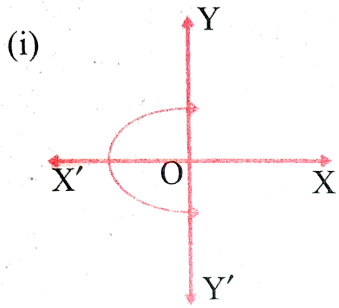
Check if this relation is a functions.



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Exercise 14

1. Determine whether the graph given below represents functions. Give reason for your answers concerning each graph



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2. Let: $f: A \rightarrow B$ be a function defined by $f(x) = \frac{x}{2} - 1$.

Where $A = \{2, 4, 6, 10, 12\}$, $B = \{0, 1, 2, 4, 5, 9\}$. Represents f by

set of ordered pairs,

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3. Represent the function

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

an arrow diagram

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4. Show that the function $f: N \rightarrow N$ defined by $f(x) = 2x - 1$

is one-one but not onto.

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5. Show that the function $f: \mathbb{N} \rightarrow \mathbb{N}$ defined by $f(m) = m^2 + m + 3$ is one-one function.

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6. Let $A = \{1, 2, 3, 4\}$ and $B = \mathbb{N}$, Let $f: A \rightarrow B$ be defined by $f(x) = x^3$ then,

Find the range of f .

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7. In each of the following cases state whether the functions is bijective or not. Justify your answer:

$f: \mathbb{R} \rightarrow \mathbb{R}$ defined by $f(x) = 2x + 1$

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8. Let $A = \{-1, 1\}$ and $B = \{0, 2\}$. If the functions $f: A \rightarrow B$ defined by $f(x) = ax + b$ is an onto function? Find a and b .

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9. If the function f is defined by

$$f(x) = \begin{cases} x + 2, & x > 1 \\ 2, & -1 \leq x \leq 1 \\ x - 1, & -3 < x < -1 \end{cases} \quad \text{then find the values of (iv)}$$

$$f(2) + f(-2)$$

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10. A function $f: [-5, 9] \rightarrow \mathbb{R}$ is defined as follows:

$$f(x) = \begin{cases} 6x + 1 & \text{if } -5 \leq x < 2, \\ 5x^2 - 1 & \text{if } 2 \leq x < 6, \\ 3x - 4 & \text{if } 6 \leq x \leq 9. \end{cases}$$

$f \in \mathcal{D}f(4) + f(8)$

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11. The distance S an object travels under the influence of gravity in time t seconds is given by $S(t) = \frac{1}{2}gt^2 + at + b$ where, (g is the acceleration due to gravity), a , b , are constants. Check if the function $S(t)$ is one-one.

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12. The function 't' which maps temperature in Celsius (C) into temperature in Fahrenheit (F) is defined by $t(C)=F$ where

$$F = \frac{9}{5}C + 32.$$

Find $t(0)$



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Exercise 1 5

1. Using the function f and g given below, find the $f \circ g$ and $g \circ f$.

Check whether $f \circ g = g \circ f$.

$$f(x) = x - 6, g(x) = x^3$$



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2. Find the value of k , such that $f \circ g = g \circ f$

$$f(x) = 2x - k, g(x) = 4x + 5$$



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3. If $f(x) = 2x - 1$, $g(x) = \frac{x + 1}{2}$, show that $f \circ g = g \circ f = x$.



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4. If $f(x) = x^2 - 1$, $g(x) = x - 2$ find a , if $\text{gof}(a)=1$.



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5. Let $A, B, C \in N$ and a function $f: A \rightarrow B$ be defined by $f(x) = 2x + 1$ and $g: B \rightarrow C$ be defined by $g(x) = x^2$. Find the range of $f \circ g$ and $g \circ f$.



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6. If $f(x) = x^2 - 1$. Find $f \circ f$



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7. If $f: R \rightarrow R$ and $g: R \rightarrow R$ are defined by $f(x) = x^5$ and $g(x) = x^4$ then check if f , g are one-one and $f \circ g$ is one-one?



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8. Consider the function $f(x)$, $g(x)$, $h(x)$ as given below. Show that $(f \circ g) \circ h = f \circ (g \circ h)$ in each case.

$f(x) = x - 1$, $g(x) = 3x + 1$ and $h(x) = x^2$.



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9. Let $f = \{(-1, 3), (0, -1), (2, -9)\}$ be linear function from Z into Z . Find $f(x)$.



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10. In electrical circuit theory, a circuit $C(t)$ called a linear circuit if it satisfies the superposition principle given by $C(at_1 + bt_2) = aC(t_1) + bC(t_2)$, where a, b are constants. Show that the circuits $C(t) = 3t$ is linear.



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Exercise 16

1. If $n(A \times B) = 6$ and $A = \{1,3\}$ then $n(B)$

A. 1

B. 2

C. 3

D. 6

Answer: C



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2. $A = \{a, b, p\}$, $B = \{2, 3\}$, $C = \{p, q, r, s\}$ then
 $n[(A \cup C) \times B]$ is

A. 8

B. 20

C. 12

D. 16

Answer: A::B



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3. If $A = \{1, 2\}$, $B = \{1, 2, 3, 4\}$, $C = \{5, 6\}$ and $D = \{5, 6, 7, 8\}$ then state which of the following statement is true.

A. $(A \times C) \subset (B \times D)$

B. $(B \times D) \subset (A \times C)$

C. $(A \times B) \subset (A \times D)$

D. $(D \times A) \subset (B \times A)$

Answer: A::B::C::D



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4. If there are 1024 relations from a set $A = \{1, 2, 3, 4, 5\}$ to a set B, then the number of elements in B is

A. 3

B. 2

C. 4

D. 8

Answer: B



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5. The range of the relation $r = \{(x, x^2) \mid x \text{ is a prime number less than } 13\}$ is

A. $\{2,3,5,7\}$

B. {2,3,5,7,11}

C. {4,9,25,49,121}

D. {1,4,9,25,49,121}

Answer: A::B::D



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6. If the ordered pairs $(a + 2, 4)$ and $(5, 2a + b)$ are equal then

(a, b) is

A. (2, -2)

B. (5, 1)

C. (2, 3)

D. (3, -2)

Answer: B::C



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7. Let $n(A) = m$ and $n(B) = n$ that the total number of non-empty relations that can be defined from A to B is

A. m^m

B. n^m

C. $2^{mn} - 1$

D. 2^{mn}

Answer: B



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8. If $\{(a,8),(6,b)\}$ represent in identity function, then the value of a and b are respectively

A. (8,6)

B. (8,8)

C. (6,8)

D. (6,6)

Answer:



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9. Let $A = \{1, 2, 3, 4\}$ and $B = \{4, 8, 9, 10\}$. A function $f: A \rightarrow B$ given by $f = \{(1, 4), (2, 8), (3, 9), (4, 10)\}$ is a

A. Many-one function

B. Identity function

C. One-to-one function

D. Into function

Answer: C



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10. If $f(x) = 2x^2$ and $g(x) = \frac{1}{3x}$, then fog is

A. $\frac{3}{2x^2}$

B. $\frac{2}{3x^2}$

C. $\frac{2}{9x^2}$

D. $\frac{1}{6x^2}$

Answer: B

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11. If $f: A \rightarrow B$ is a bijective function and if $n(B) = 7$, then $n(A)$ is equal to

A. 7

B. 49

C. 1

D. 14

Answer:

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12. Let f and g be two functions given by
 $f = \{(0, 1), (2, 0), (3, -4), (4, 2), (5, 7)\}$

$g(x) = \{(0, 2), (1, 0), (2, 4), (-4, 2), (7, 0)\}$ then the range of fog is ___.

A. $\{0, 2, 3, 4, 5\}$

B. $\{-4, 1, 0, 2, 7\}$

C. $\{1, 2, 3, 4, 5\}$

D. $\{0, 1, 2\}$

Answer: A::B



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13. Let $f(x) = \sqrt{1 + x^2}$ then

A. $f(xy) = f(x).f(y)$

B. $f(xy) \geq f(x).f(y)$

C. $f(xy) \leq f(x).f(y)$

D. None of these

Answer:



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14. If $g = \{(1, 1), (2, 3), (3, 5), (4, 7)\}$ is a function given by $g(x) = \alpha x + \beta$ then the values of α and β are

A. (-1,2)

B. (2,-1)

C. (-1,-2)

D. (1,2)

Answer: A::B

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15. $f(x) = (x + 1)^3 - (x - 1)^3$ represents a functions which is

A. linear

B. cubic

C. reciprocal

D. quadratic

Answer: A::C::D

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Unit Exercise

1. If the ordered pairs $(x^2 - 3x, y^2 + 4y)$ and $(-2, 5)$ are equal, then find x and y .



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



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3. Given that $f(x) = \{(\sqrt{x-1}, x \geq 1), (4, x < 1)\}$

find $f(0)$



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4. Let $A = \{9, 10, 11, 12, 13, 14, 15, 16, 17\}$ and let $f: A \rightarrow \mathbb{N}$ be defined by $f(n) =$ the highest prime factor of $n \in A$. Write f as a set of ordered pairs and find the range of f .

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5. Find the domain of the function

$$f(x) = \sqrt{1 + \sqrt{1 - \sqrt{1 - x^2}}}$$

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6. If $f(x) = x^2$, $g(x) = 3x$ and $h(x) = x - 2$. Prove that $(f \circ g) \circ h = f \circ (g \circ h)$.

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7.

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

. Verify whether $A \times C$ is a subset of $B \times D$?



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8. If $f(x) = \frac{x-1}{x+1}$, $x \neq 1$ show that $f(f(x)) = \frac{-1}{x}$ provided $x \neq 0$.



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9. The function f and g are defined by

$$f(x) = 6x + 8, g(x) = \frac{x-2}{3}.$$

Calculate the value of $g\left(\frac{g(1)}{2}\right)$



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10. Write the domain of the following real functions

$$f(x) = \frac{2x + 1}{x - 9}$$



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Additional Questions Solved

1. If $n(A \times B) = 15$ and $A = \{1,3,7\}$ then $n(B)$ is

A. 3

B. 5

C. 1

D. 15

Answer:



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2. If $A = \{a,b,c\}$ $B = \{b,d,e\}$

$C = \{a,e,l,o,u\}$ then $n [(A \cap C) \times B]$ is

A. 18

B. 36

C. 9

D. 3

Answer: C



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3. If there are 28 relation from a set $A = \{2,4,6,8\}$ to a set B , then the number of elements in B is

A. 7

B. 14

C. 5

D. 4

Answer:



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4. The ordered pairs $(a + 7, 4)$ and $(3, 4a + b)$ are equal then (a, b) is

..... .

A. (4,20)

B. (20,4)

C. (-4,20)

D. (20,-4)

Answer:



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5. The range of the relation $R = \{(x, x^3) / x \text{ is a prime number less than } 13\}$ is

A. $\{2,3,5,7,11\}$

B. $\{4,9,25,49,121\}$

C. $(8,27,125,343,1331)$

D. $\{1,8,27,125,343,1331\}$

Answer: A::B::C::D



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6. If $\{(x,2), (4,y)\}$ represents an identity function, then (x,y) is

A. (2,4)

B. (4,2)

C. (2,2)

D. (4,4)

Answer: B::D



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7. If $\{(7,11), (5,a)\}$ represents a constant function, then the value of

'a' is

A. 7

B. 11

C. 5

D. 9

Answer: B



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8. Given $f(x) = (-1)^x$ is a function from N to Z . then the range of f is

A. {1}

B. N

C. {1,-1}

D. Z

Answer: c



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9. If $f = \{(6,3),(8,9),(5,3),(-1,6)\}$, then the pre-image of 3 are

A. 5 and -1

B. 6 and 8

C. 8 and -1

D. 6 and 5

Answer: A::D



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10. Let $A = \{1,3,4,7,11\}$, $B = \{-1,1,2,5,7,9\}$ and $f : A \rightarrow B$ be given by

$$f = \{(1,-1),(3,2),(4,1),(7,5),(11,9)\}$$

then f is

A. one-one

B. onto

C. bijective

D. not a function

Answer:



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11. The given diagram represents

A. an onto function

B. a constant function

C. an one-function

D. not a function

Answer: A::C



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12. If $A = \{5,6,7\}$, $B = \{1,2,3,4,5\}$ and $f : A \rightarrow B$ is defined by $f(x) = x - 2$, then the range of f is

A. $\{1,4,5\}$

B. $\{1,2,3,4,5\}$

C. $\{2,3,4\}$

D. $\{3,4,5\}$

Answer: C::D



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13. If $f(x) = x^2 + 5$, then $f(-4) = \dots\dots\dots$.

A. 26

B. 21

C. 20

D. - 20

Answer: A::B



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14. If the range of a function is a singleton set , then it is

- A. a constant function
- B. an identity function
- C. a bijective function
- D. a one-one function

Answer: A::C



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15. If $f: A \rightarrow B$ is a bijective function and if $n(A) = 5$, then $n(B)$ is equal to ____.

- A. 10
- B. 4
- C. 5
- D. 25

Answer:



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16. If $f, \mathbb{R} \rightarrow \mathbb{R}$ defined by $f(x) = 3x - 6$ and

$g: \mathbb{R} \rightarrow \mathbb{R}$ defined by $g(x) = 3x + k$ if $f \circ g = g \circ f$ then the value of k is

A. -5

B. 5

C. 6

D. -6

Answer:



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17. If $f(x) = x^2 - x$ then $f(x-1) - f(x+1)$ is

A. $4x$

B. $4x + 2$

C. $2 - 4x$

D. $4x - 2$

Answer: B::D



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18. If $K(x) = 3x - 9$ then $L(x) = 7x - 10$ then LOK is

A. $21x + 73$

B. $-21x + 73$

C. $21x - 73$

D. $22x - 73$

Answer: A::B::C



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19. Composition of function is associative.

A. commutative

B. associative

C. commutative and associative

D. not associative

Answer: A::C



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20. A comet is heading for jupiter with axxeleration $a = 50 \text{ km s}^{-2}$. The velocity of the comet at time "t" is given by $f(t) = at^2 - at + 1$. then the velocity at time $t = 5$ seconds is

- A. 900 km s^{-1}
- B. 1001 km s^{-1}
- C. 2001 km s^{-1}
- D. 50 km s^{-1}

Answer: A



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Additional Questions Solved Answer The Following Questions

1. If $A = \{2,3,5\}$ and $B = \{1,4\}$ then find

(i) $A \times B$ (ii) $B \times A$



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2. If $A \times B = \{(a,x)(a,y),(b,x),(b,y),(c,x)(c,y)\}$ then find A and B



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3. Let $A = \{x \in \mathbb{W} / 3 < x < 7\}$,

$B = \{x \in \mathbb{N} / 0 < x < 3\}$, $C = \{x \in \mathbb{W} / x < 2\}$ verify A

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



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4. Let $A = \{10,11,12,13,14\}$, $B = \{0,1,2,3,5\}$ and $f_i: A \rightarrow B$, $i = 1, 2,3$, state the type of function for the following (give reason) :

(i) $f_1 = \{(10,1),(11,2),(12,3),(13,5),(14,3)\}$

$f_2 = \{(10,1),(11,1),(12,1),(13,1),(14,1)\}$

(iii) $f_3 = \{(10, 0), (11, 1), (12, 2), (13, 3), (14, 5)\}$

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5. If $X = \{1,2,3,4,5\}$, $Y = \{1,3,5,7,9\}$ determines which of the following relations from X to Y are functions ? Give reason for your answer.

If it is a function. State its type.

(i) $R_1 = \{(x,y) \mid y = x + 2, x \in X, y \in Y\}$

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

(iii) $R_3 = \{(1,1),(1,3),(3,5),(3,7),(5,7)\}$

(iv) $R_4 = \{(1,3),(2,5),(4,7),(5,9),(3,1)\}$

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6. $A = \{-2, -1, 1, 2\}$ and $f = \left\{ \left(x, \frac{1}{x} \right) : x \in A \right\}$.

Write down the range of f . Is f a function from A to A ?



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7. Let $A = \{5, 6, 7, 8\}$,

$B = \{-11, 4, 7, -10, -7, -9, -13\}$ and $f = \{(x, y) : y = 3 - 2x, x \in A, y \in B\}$.

(i) Write down the elements of f .

(ii) What is the co-domain?

(iii) What is the range?

Identify the type of function.



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8. Let $A = \{1, 2, 3, 4, 5\}$, $B = N$ and $f: A \rightarrow B$ be defined by $f(x) = x^2$. Find the range of f . Identify the type of function.



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9. Find the domain and range of the following

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



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10. Given $P = \{-2, -1, 0, 1\}$

$Q = \{1, -2, 6, -3\}$

$R = \{x, y / y = x^2 - 3 \mid x \in P, y \in Q\}$

(i) List the elements of R

(ii) is the relation a function? If so identify the function



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11. Given $f(x) = 3x - 2$, $g(x) = 2x^2$ find

(i) $f \circ g$ and (ii) $g \circ f$ what do you find

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12. If $f: \mathbb{R} \rightarrow \mathbb{R}$ is defined by $f(x) = ax + 3$

and $g: \mathbb{R} \rightarrow \mathbb{R}$ is defined by $g(x) = 4x - 3$

find a so that $f \circ g = g \circ f$

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13. Given $f(x) = 3 + x$, $g(x) = x^2$, $h(x) = \frac{1}{x}$ find $f \circ (g \circ h)$

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14. If $f(x) = x + 3$ where $A = \{4, 6, 8, 10\}$

$B = \{7, 9, 11, 13\}$ and $f: A \rightarrow B$

(i) Draw the arrow diagram

(ii) Why type of function is f .



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

$C = \{2, 5\}$, $D = \{2, 3, 5\}$ check if

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



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16. Study the relation given below an set builder form. Represent each of them by

(a) an arrow diagram

(b) a graph (c) a set in roster.

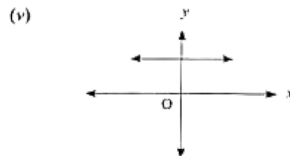
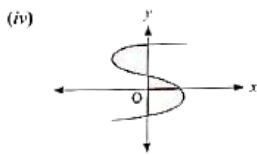
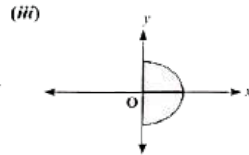
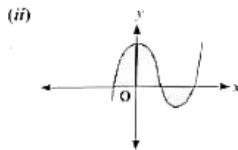
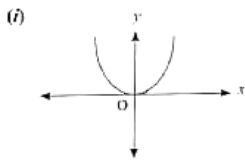
If $\{(x,y) / y = 2x + 1, x < 10 \text{ and}$

$y < 12, x \in \mathbb{N}, y \in \mathbb{N}\}$

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17. State whether the following graphs represent a function.

Give reason for your answer.



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18. Let $A=\{6,9,15,18,21\}$, $B=\{1,2,4,5,6\}$ and $f: A \rightarrow B$ be defined by

$$f(x) = \frac{x - 3}{3}$$

Represent f by , (i) an arrow diagram (ii) a set of ordered pairs
(iii) a table (iv) a graph .



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19. Let $A = \{4,6,8,10\}$ and $B = \{3,4,5,6,7\}$.

If $f: A \rightarrow B$ is defined by $f(x) = \frac{1}{2}x + 1$

then represent f by (i) an arrow diagram , (ii) a set of ordered pairs and, (iii) a table .



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20. A function $f: [-3, 7] \rightarrow \mathbb{R}$ is defined as follows $f(x) =$

$$\begin{cases} 4x^2 - 1 & -3 \leq x < 2 \\ 3x - 2 & 2 \leq x \leq 4 \\ 2x - 3 & 4 < x < 7 \end{cases}$$

Find (i) $f(5) + f(6)$ (ii) $f(1) - f(-3)$ (iii) $f(-2) - f(4)$ (iv) $\frac{f(3) + f(-1)}{2f(6) - f(1)}$



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21. A function $f: [-7, 6) \rightarrow \mathbb{R}$ is defined as follows.

$$f(x) = \begin{cases} x^2 + 2x + 1 & -7 \leq x < -5 \\ x + 5 & -5 \leq x \leq 2 \\ x - 1 & 2 < x < 6 \end{cases}$$

Find $2f(-4) + 3f(2)$



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22. Let $A = \{0, 1, 2, 3\}$ and $B = \{1, 2, 3, 5, 7, 9\}$ be two sets.

Let $f: A \rightarrow B$ be a function given by $f(x) = 2x + 1$.

Represents this function as

a set of ordered pairs



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23. A function $f : (1,6) \rightarrow \mathbb{R}$ is defined as follows

$$f(x) = \begin{cases} 1 + x & 1 \leq x < 2 \\ 2x - 1 & 2 \leq x < 4 \\ 3x^2 - 10 & 4 \leq x < 6 \end{cases} \text{ (here, } (1,6) = \{x \in \mathbb{R} : 1 \leq x < 6\} \text{)}$$

Find the value of (i) $f(5)$ (ii) $f(3)$ (iii) $f(1)$ (iv) $f(2) - f(4)$ (v) $2f(5) - 3f(1)$.



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24. Given $f(x) = 5x + 2$, $g(x) = 2x - 3$,

$h(x) = 3x + 1$, Verify $f \circ (g \circ h) = (f \circ g) \circ h$



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25. Given $f(x) = x^2 + 4$: $g(x) = 3x - 2$:

$h(x) = x - 5$, show that the composition of functions is associative.

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26. Given $f(x) = x - 2$: $g(x) = 3x + 5$:

$h(x) = 2x - 3$. Verify that

$(goh) \circ f = go(hof)$

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