



MATHS

BOOKS - NAGEEN MATHS (HINGLISH)

RELATIONS AND FUNCTIONS

Solved Examples

1. If $(2x + 3, y-1) = (3, 5)$, then find x and y .

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2. If $A = \{3, 4\}$ and $B = \{2, 3, 4\}$, then evaluate $A \times B$.

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3. If $A=\{1,2\}$ and $B=\{2,3\}$, then show that:

$$A \times B \neq B \times A$$

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

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5. A and B are two sets and $n(A \times B) = 6$. If three elements of $A \times B$ are $(1,2), (2,3), (3,3)$, then find A and B.

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6. If $A = \{a, b\}$, $B = \{2, 3\}$ and $C = \{3, 4\}$, then evaluate:

(i) $A \times (B \cap C)$ (ii) $A \times (B \cup C)$

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7. If $A \subseteq B$ and C be any set, then prove that:

$$A \times C \subseteq B \times C$$

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8. If $A \subseteq B$ and $C \subseteq D$, then prove that:

$$A \times C \subseteq B \times D$$

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9. For any A sets A, B, C and D, prove that:

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

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10. If n elements are common in sets A and B, then prove that n^2 elements will be common in the set $A \times B$ and $B \times A$.

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11. Following relations from the set of natural number N to N are given:

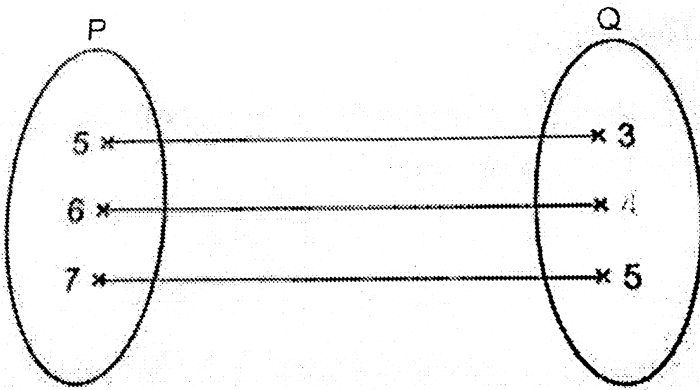
$$(a) R_1 = \{(1, 2), (4, 2), (9, 3), (16, 4), \dots\}$$

$$(b) R_2 = \{(3, 1), (4, 2), (5, 3), (6, 4), \dots\}$$

Represent them in set builder form.

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12. A relation R is represent from set P to Q in the following diagram:



Write it in Roaster and Set builder form. Write the diagram and range of the relation.

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13. If $A = \{1, 2, 3\}$ and $B = \{4, 5, 6\}$, then which of the following is a relation from set to B? Give reason:

(i) $R_1 = \{(1, 5), (2, 4), (3, 5)\}$

$$(ii) R_2 = \{(4, 1), (2, 6), (5, 1), (2, 4)\}$$

$$(iii) R_3 = \{(1, 4), (2, 5), (3, 4), (2, 6), (3, 6)\}$$

$$(iv) A \times B$$



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14. Let R be a relation from set Q to Q defined as:

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

Prove that

$$(i) \text{ For each } a \in Q, (a, a) \in R$$

$$(ii) (a, b) \in R \Rightarrow (b, c) \in R \text{ where } a, b \in Q$$

$$(iii) (a, b) \in R, (b, c) \in R \Rightarrow (a, c) \in R, \text{ where } a, b, c \in Q$$



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15. Check whether the following relations are functions or not:

$$R_1 = \{(2, 1), (5, 1), (8, 1), (11, 1), (14, 1), (17, 1)\}$$

$$(ii) R_2 = \{(2, 1), (4, 2), (6, 3), (8, 4), (10, 5), (12, 6), (14, 7)\}$$

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



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16. If $A = \{1, 2, 3\}$ and $B = \{2, 3, 4\}$, find which of the following are the functions from A to B?

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

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

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



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17. Let R be a relation on the set of natural numbers N, defined as:

$$R = \{(x, y) : y = 2x, x, y \in N\}.$$

Is R a function from $N \times N$? If yes find the domain, co-domain and range of R.



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18. If $f = \{(1, 1), (2, 3), (3, 5), (4, 7)\}$, is a linear function from Z to Z , then find $f(x)$.



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19. Let A be a set of two positive integers and a function $f: A \rightarrow Z^+$ is defined as $f(n) = p$, where p is largest prime factor of n .

if the range of f is $\{3\}$, then find A . Can A exist uniquely?



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20. If $f(x) = x^2 + 5x - 3$, then evaluate $f(4)$



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21. If $f(x) = 2(1 + \sin x)$, then evaluate $f\left(\frac{\pi}{2}\right)$.

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22. If $f: R \rightarrow R$ is defined as:

$$f(x) = \begin{cases} 2x + 5, & x > 9 \\ x^2 - 1, & -9 < x < 9 \\ x - 4, & x < -9 \end{cases}$$

then evaluate (i) $f(2)$, (ii) $f(10)$, (iii) $f(-12)$ and (iv) $f[f(3)]$.

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23. If $f(x) = x^3 - \frac{1}{x^3}$, then find the value of $f(x) + f(-x)$.

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24. Let $f(x)$ is a real function, defines as $f(x) = \frac{x-1}{x+1}$, then prove that $f(2x) = \frac{3f(x)+1}{f(x)+3}$.

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25. If $y = f(x) = \frac{x+2}{x-1}$, $x \neq 1$, then show that $x = f(y)$.

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26. If for $x \neq 0$, $af(x) + bf\left(\frac{1}{x}\right) = \frac{1}{x} - 5$, $a \neq b$, then $f(x)$.

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27. If $f(x) = \cot x$, then prove that :

$$f(-x) = -f(x)$$

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28. If $f(x) = \log_e \left(\frac{1-x}{1+x} \right)$; prove that
- $$f(a) + f(b) = f\left(\frac{a+b}{1+ab}\right)$$

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29. If $f(x) = \frac{x-1}{x+1}$, then prove that $f\{f(x)\} = -\frac{1}{x}$.

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30. If $f(x) = x^2$ and $g(x) = 2x + 1$ are two real valued function, then evaluate :

$$(f+g)(x), (f-g)(x), (fg)(x), \frac{f}{g}(x)$$

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31. Find range of $f(x) = \frac{x - 3}{4 - x}$.

A. R

B. $\mathbb{R} - \{1\}$

C. $\mathbb{R} - \{-1\}$

D. None of these

Answer: C



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32. Find the domain and range of $f(x) = \frac{1}{\sqrt{x - 2}}$



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33. Find the domain and range of

$$f(x) = \frac{x}{a + x^2}$$

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34. Find the domain and range of the function $f(x) = \frac{x^2 - 9}{x - 3}$

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35. Find the domain and range of $f(x) = \frac{1}{2 - \sin 3x}$.

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

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2. Find the values of x and y from each of the following

(i) $(x + y, x - 2y) = (7, 1)$

(ii) $(2x, x + 3y) = (4, 5)$

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

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4. If $A = \{1, 2\}$, then find $A \times A \times A$.

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5. If $A = \{x, y, z\}$ and $B = \{2, 3\}$, then find $A \times B$.

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6. If $A = \{1, 2, 3, 4\}$ and $B = \{x : x \in \mathbb{N} \text{ and } x, \text{ is a prime number less than } 5\}$, then find $A \times B$ and $B \times A$.

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7. If $A \times B = \{(a, 3), (a, 5), (b, 3), (b, 5), (c, 3), (c, 5)\}$, then find $B \times A$.

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8. Find whether the following statements are true or false. If the statement is false, then write its correct statement:

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

(ii) If A and B are non-empty sets, then $A \times B$ is a non-empty set of the ordered pairs (x,y) such that $x \in A$ and $y \in B$.



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9. 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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10. If $A \times B = \{(a, 2), (b, 4), (a, 6), (b, 2), (b, 6), (a, 4)\}$, then find A and B.

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11. If $A = \{1, 2, 3\}$, $B = \{3, 4\}$ and $C = \{4, 5, 6\}$, then find each of the following :

(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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12. If $A = \{1, 2, 3, 4, 5\}$, $B = \{1, 2, 3, 6, 7\}$ and $C = \{8\}$, then find $(A - B) \times C$.

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13. If $A=\{1,2\}$ and $B=\{x,y\}$, then find $A \times B$. Also find the number of its subsets.

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14. If $A=\{-1,1\}$, then find $A \times A \times A$.

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15. If $A=\{1,2,3\}$ and $B=\{1,2\}$, then represent $A \times B$ graphically.

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16. If $A = \{x,y,z\}$ and $B=\{5,6\}$, then represent each of the following by arrow diagram:

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

$$(iii) A \times A \quad (iv) B \times B$$



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17. The set A and B has 3 common elements . If $n(A) = 5$ and $n(B) = 4$, then find $n(A \times B)$ and $x\{(A \times B) \cap (B \times A)\}$



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18. $\subseteq B$, then prove that $A \times A \subseteq (A \times B) \cap (B \times A)$.



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19. Let A be a non-empty set such that $A \times B = A \times C$. Show that $B = C$.

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20. If A and B are any two non-empty sets, then prove that:

$$A \times B = B \times A = A \times A = B \times B.$$

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Exercise 2 B

1. If $A = \{a, b, c, d\}$ and $B = \{w, x, y, z\}$, then which of the following is a relation from set A to B ? Given reason:

(i) $R_1 = \{(a, w), (a, x), (a, y), (a, z)\}$

(ii) $R_2 = \{(w, b), (z, c), (y, d)\}$

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

(iv) $R_4 = \{(b, z), (b, y), (c, z), (c, w)\}$

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2. Set A has 5 elements and set B has 3 elements. Find the number of relations from set A to B.

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3. If $A=\{a,y\}$ and $B=\{2,5\}$, then find the number of relations from set A to B.

A. 4

B. 8

C. 16

D. 32

Answer: C

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4. If $A=\{1,2,3,4\}$ and $B=\{5,7,8,11,15\}$, are two sets and a relation R from A to B is defined as follows:

$$xRy \Leftrightarrow 2x + 3, \text{ where } x \in A, y \in B$$

- (i) Express R in Roaster form.
- (ii) Find the domain and range of R .
- (iii) Find R^{-1} .
- (iv) Represent R by arrow diagram.

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5. If $A=\{2,4,6,8\}$ and $B=\{1,3,5\}$, then find the domain and range of the relation:

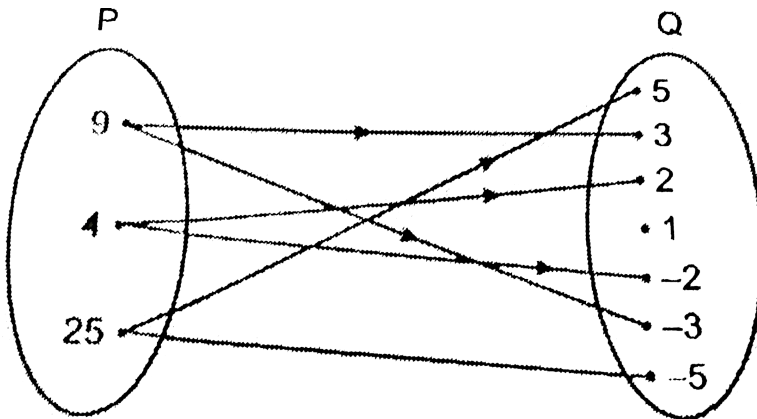
$$R\{(x, y) : x \in A, y \in B \text{ and } x > y\}$$

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6. If $A = \{1, 2, 3, 4, 5, 6\}$, then define a relation $R = \{(x, y) : y = x - 1\}$, from A to A.

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7. A relation R is shown from sets P to Q in the following diagram:



write this relation in Roaster form and in Set builder form. Also find the domain, co-domain and range of the relation.

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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. A is a set of first 10 natural numbers and R is a relation from A to A defined as:

$$(x, y) \in R \Leftrightarrow x + 2y = 10 \text{ when } x, y \in A$$

- (i) Express R in the form of a set of ordered pairs.
- (ii) Find the domain and range of R.
- (iii) Find R^{-1} .

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10. A relation R_1 is defined on the set of real numbers as follows:

$$(a, b) \in R_1 \Leftrightarrow 1 + ab > 0, \text{ when } a, b \in \mathbb{R}$$

(iii) $(a, b) \in R_1$ and $(b, c) \in R_1 \rightarrow (a, c) \in R_1$ is not true when

$a, b, c, \in R$



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11. A relation R is defined on the set of N_2 as follows :

$$R: \{(a, b) : a, b \in N \text{ and } a = b^2\}$$

Check whether the following statements are true ?

(i) For each $a \in N$, $(a, a) \in R$

(ii) $(a, b) \in R$ and $(b, c) \in R$, when $a, b \in N$

(iii) $(a, b) \in R$ and $(b, c) \in R \rightarrow (a, c) \in R$, when $a, b, c \in N$



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12. If set $A = \{1, 2, 3, 4\}$ and a relation R is defined from A to A as

follows:

$$R = \{(x, y) : x > 1, y = 3\}$$

Find the domain and range of R.



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13. A relation R is defined from the set of integer Z to Z as follows:

$$(x, y) \in Z \Leftrightarrow x^2 + y^2 = 25$$

(i) Express R and R^{-1} as the set of ordered pairs.

(ii) Write the domain of R and R^{-1} .



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14. If $A = \{1, 2, 3, 4, 6\}$ and a relation R on A is defined as follows :

$$R = \{(a, b) : a, b \in A, a \text{ divides } b\}, \text{ then}$$

(i) Write R in Roaster form.

(ii) Find the domain of R.

(iii) Find the range of R.



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Exercise 2 C

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



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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) $R = \{(1, 2$



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3. If $X = \{1, 2, 3, 4, 5\}$ and $Y = \{1, 3, 5, 7, 9\}$, then find which of the following sets are functions from X to Y ?

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

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

(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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4. Let R be a relation defined on the set of natural numbers as:

$$R = \{(x, y) : y = 3x, y \in N\}$$

Is R a function from N to N ? If yes find its domain, co-domain and range.



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5. Express each relation in the form of ordered pair and check whether is it a function or not?

$$(i) f = \{(x, y) : y = 3x, x \in \{1, 2, 3\}, y \in \{3, 6, 9, 12\}\}$$

$$(ii) g = \{(x, y) : y > x + 1, x \in \{1, 2\}, y \in \{2, 4, 6\}\}$$

$$(iii) h = \{(x, y) : x + y = 3, x, y \in \{0, 1, 2, 3\}\}$$



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6. A function $f: R \rightarrow R$ is defined as:

$$f(x) = \begin{cases} 1 & x \in Q \\ -1 & x \notin Q \end{cases}$$

Evaluate each of the following:

$$(i) f(2), f(\pi) \quad (ii) \text{Range of } f$$

$$(iii) f^{-1}(-1) \quad (iv) f^{-1}(1)$$



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7. Find which of the following are the function on set $A = \{a, b, c\}$? Give reason.

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

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

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8. A function $f: R \rightarrow R$ is defined as $f(x) = x^2 - 1$. Evaluate each of the following:

(i) $f^{-1}(-2)$ (ii) $f^{-1}(17)$

(iii) $f^{-1}(26, 50)$ (iv) $f^{-1}(0)$

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9. If $A = \{-3, -2, -1, 0, 1, 2, 3\}$ and $f: A \rightarrow Z$ is a function which of the following :

(i) Range of f

(ii) Pre-image of 5

(iii) Pre-image of 0



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10. If $A = \{1, 2, 3, 4\}$, $B = \{1, 5, 9, 11, 15, 16\}$ and $f = \{(1, 5), (2, 9), (3, 1), (4, 5), (2, 11)\}$ are the following statements true ?

(i) f is a relation from A to B .

(ii) f is a function from A to B

Justify your answer.



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11. If $A = \{9, 10, 11, 12, 13\}$ and a function $f: A \rightarrow N$ is defined as $f(n) =$ largest prime factor of n . If the range of f is B , then find B .



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12. If $A=\{1,2\}$ and $B=\{3,6\}$ and two functions $f:A \rightarrow B$ and $g:A \rightarrow B$ are defined respectively as :

$$f(x) = x^2 + 2 \text{ and } g(x) = 3x$$

Find whether $f = g$



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13. Express the following functions in the form of order pairs and find their range:

(i) $f:A \rightarrow R, f(x) = x^2 + 5$, where $A = \{-2, -1, 0, 1\}$

$g:A \rightarrow N, g(x) = 3x$, where $A = \{x : x \in N, x < 4\}$



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14. If a function $f: R \rightarrow R$ is defined as $f(x) = x^2 + 1$, then find each of the following :

(i) $\{x, f(x) = 26\}$

(ii) Pre-image of 17 under f

(iii) Pre-image of 2 under f



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15. Let a function $f: R^+ \rightarrow R$ is defined as $f(x) = \log_e x$, then find each of the following:

(i) Range of f

(ii) $f(x) = -2$

(iii) Is $f(xy) = f(x) + f(y)$ true ?



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16. A function $F(c)$ is defined as :

$$F(c) = \frac{9}{5} \cdot c + 32.$$

Evaluate each of the following:

(i) $F(0)$

(ii) $F(28)$

(f-10)

(iv) Value of c when $F(c)=212$



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17. If $f(x)=2x-5$, then evaluate the following:

(i) $f(0)$

(ii) $f(7)$

(iii) $f(-3)$



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18. If $f(x) = x^2$, then evaluate: $\frac{f(1 \cdot 2) - f(1)}{1 \cdot 2 - 1}$

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19. If $f(x) = x^2$, then evaluate: $\frac{f(x+1) - f(x-1)}{4x}$

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20. If $f(x) = \frac{x}{x-1}$, then evaluate: $\frac{f(a/b)}{f(b/a)}$

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21. If $f(x) = \frac{x-1}{x+1}$, then prove that:

$$\frac{f(b) - f(a)}{1 + f(b) \cdot f(a)} = \frac{b - a}{1 + ab}$$

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22. If $f(x) = \frac{1}{1-x}$, then prove that : $f[f\{f(x)\}] = x$

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23. If $f(x) = \tan x$, the prove that : $f(x) + f(-x) = 0$

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24. If $f(x) = x + \frac{1}{x}$, then prove that :

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

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25. If $y = f(x) = \frac{ax - b}{bx - a}$, the prove that : $x = f(y)$

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26. If $y(x) = \sin x + \cos^2 x$, then prove that:

$$f(x) = f(\pi - x)$$

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27. If $f(x) = \frac{1 - x^2}{1 + x^2}$, then prove that:

$$f(\tan \theta) = \cos 2\theta$$

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28. If $f(x) = x^2 + x + 1$, then find the value of 'x' for which

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

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29. If $f(x) = \log_e x$, then prove that

$$: f(xyz) = f(x) + f(y) + f(z)$$

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30. If $f(x) = \log_e x$ and $g(x) = e^x$, then prove that :

$$f\{g(x)\} = g\{f(x)\}$$

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31. If $f(x) = \sqrt{\frac{1-x}{1+x}}$, then evaluate : $f(\cos 2\theta)$

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32. If $f(x) = \log \frac{1+x}{1-x}$, then prove that:

$$f\left(\frac{2x}{1+x^2}\right) = 2f(x)$$

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33. If $f: R \rightarrow R$ is defined as:

$$f(x) = \begin{cases} 2x + 1 & \text{if } x > 2 \\ x^2 - 1 & \text{if } -2 < x < 2 \\ 2x & \text{if } x < -2 \end{cases}$$

then evaluate the following:

(i) $f(1)$

(ii) $f(5)$

(iii) $f(-3)$

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34. If $f(x) = \cos(\log x)$, then

$$f(x)f(y) - \frac{1}{2} \left[f\left(\frac{x}{y}\right) + f(xy) \right] =$$

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35. If $f(x) = 3 \cos x$ and $g(x) = \sin^2 x$, the evaluate:

$$(f + g)\left(\frac{\pi}{2}\right)$$

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36. If $f(x) = x^2$ and $g(x) = 2x$, then evaluate,

(i) $(f + g)(3)$ (ii) $(f - g)(2)$

(iii) $(f \cdot g)(1)$ (iv) $\left(\frac{f}{g}\right)(5)$

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Exercise 2 D

1. Find the domain of the following functions:

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

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2. Find the domain of the following functions:

$$\frac{1}{x + 1}$$

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3. Find the domain of the following functions:

$$\frac{x - 2}{x + 4}$$

A. R

B. $R-\{2\}$

C. $R-\{-4\}$

D. $R-\{4\}$

Answer: C



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4. Find the domain of the following functions:

$$\frac{1}{x^2 - 4}$$



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5. Find the domain of the following functions:

$$\sqrt{x - 4}$$

A. $[4, \infty]$

B. $[0, \infty]$

C. $(-\infty, 4]$

D. None of these

Answer: A

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6. Find the domain of the following functions:

$$\frac{1}{\sqrt{x-6}}$$

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7. Find the domain of the following functions:

$$\frac{1}{\sqrt{4-x}}$$



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8. Find the domain of the following functions:

$$\sqrt{(x - 2)(4 - x)}$$



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9. Find the domain of the following functions:

$$\frac{1}{\sqrt{25 - x^2}}$$



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10. Find the domain of the following functions:

$$\frac{x^2 + 5x + 30}{x^2 - 8x + 7}$$

A. $\mathbb{R} - \{1, 7\}$

B. $\mathbb{R} - [1,7]$

C. \mathbb{R}

D. $\mathbb{R} - \{1\}$

Answer: A



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11. Find the domain and range of the following functions:

$$\frac{x - 3}{2 - x}$$



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12. Find the domain and range of the following functions:

$$\frac{1}{\sqrt{x - 3}}$$



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13. Find the domain and range of the following functions:

$$\frac{x^2}{1 + x^2}$$



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14. Find the domain and range of the following functions:

$$\frac{x^2 - 4}{x - 2}$$



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15. Find the domain and range of the real function

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



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16. Find the domain and range of the following functions:

$$\sqrt{2-x}$$



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17. Find the domain and range of the following functions:

$$\frac{1}{\sqrt{x}}$$



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18. Find the domain and range of the following functions:

$$\sqrt{1-x^2}$$



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1. If $f(x) = x$ and $g(x) = |x|$, then define the following functions:

(i) $f + g$ (ii) $f - g$

(iii) $f \cdot g$ (iv) $\frac{f}{g}$

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2. Find the domain of $f(x) = \frac{1}{x - |x|}$, when $x \in R$

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3. Find the domain of the function $\log|4 - x^2|$.

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4. Find the domain and range of $f(x) = -|x|$.



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5. Find the domain and range of $f(x) = |x - 1|$

A. Domain = \mathbb{R} , Range = $[0, \infty)$

B. Domain = $(-3, 3)$, Range = $[0, -\infty)$

C. Domain = \mathbb{R} , Range = $[7, \infty)$

D. None of above

Answer: A



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1. If $f = \{(2, 3), (3, 4), (4, 5)\}$, then its inverse is :

A. $\{(3, 4), (4, 5), (3, 2)\}$

B. $\{(3, 2), (4, 3), (5, 4)\}$

C. $\{(2, 3), (4, 3), (5, 4)\}$

D. None of these

Answer: b



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2. If $f(x) = \frac{x + 1}{x - 1}$, then the value of $f\{f(3)\}$ is :

A. 3

B. 2

C. 6

D. None of these

Answer: a

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3. If $f(x) = \frac{x^2}{1+x^2}$, then the value of $f\{f(2)\}$ is :

A. $\frac{9}{41}$

B. $\frac{25}{41}$

C. $\frac{16}{25}$

D. $\frac{16}{41}$

Answer: d

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4. If $f(x) = x - \frac{1}{x}$, then the value of $f(x) + f\left(\frac{1}{x}\right)$ is :

A. 0

B. $2x$

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

D. None of these

Answer: a

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5. If $f(x) = \log_e \left(\frac{1-x}{1+x} \right)$, then $f\left(\frac{2x}{1+x^2}\right)$ is equal to :

A. $[f(x)]^2$

B. $2f(x)$

C. $4f(x)$

D. None of these

Answer: b

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6. The domain of $f(x) = \frac{x^2}{x^2 - 3x + 2}$ is :

A. R

B. $R - \{1\}$

C. $R - \{1,2\}$

D. $R - \{-1,-2\}$

Answer: c

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7. The range of $f(x) = \frac{|x|}{x} x \neq 0$ is :

A. $[0,1]$

B. $[-1,1]$

C. $(-1,1)$

D. $\{-1,1\}$

Answer: D



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8. The domain of $f(x) = \frac{1}{\sqrt{x-3}}$ is :

A. $(-\infty, 3)$

B. $(3, \infty)$

C. $[3, \infty)$

D. None of these

Answer: B

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9. The range of function $f(x) = |x + 2|$ is :

A. \mathbb{R}

B. $[0, \infty[$

C. $] - \infty, 0]$

D. $]0, \infty[$

Answer: B

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10. If $f(x) = \frac{1}{1-x}x \neq 1$ and $g(x) = \frac{x-1}{x}$, $x \neq 0$, then the value of $g[f(x)]$ is :

A. $-x$

B. x

C. $2x$

D. None of these

Answer: b



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Exercise 2 G

1. If $f(x) = \cos(\log x)$, then $f(x)f(y) - \frac{1}{2} \left[f\left(\frac{x}{y}\right) + f(xy) \right] =$

A. 0

B. $f(x + y)$

C. $\frac{1}{2} \cdot f(x)f(y)$

D. None of these

Answer: a



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2. If $f(x) = (a - x^n)^{1/n}$ where $a > 0$ and $n \in \mathbb{N}$, then $f[f(x)]$

is equal to :

A. x

B. a

C. x^n

D. None of these

Answer: a



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3. If $f(x) = |x + 1|$ then the true statement from the following is

:

A. $f(x^2) = \{f(x)\}^2$

B. $f(x + y) = f(x) + f(y)$

C. $f(|x|) = |f(x)|$

D. None of these

Answer: d



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4. If $f(x) = 3x + |x|$, then the value of $f(3x) + f(-x) - f(x)$ is:

A. $3(x + |x|)^2$

B. $3(x + |x|)$

C. $(x - |x|)^3$

D. None of these

Answer: B

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5. If $A = \left\{ x : \frac{\pi}{6} < x < \frac{\pi}{3} \right\}$ and $f(x) = \cos x - x(1 + x)$, then $f(A)$ is equal to :

A. $\left[(\pi), (6), \frac{\pi}{3} \right]$

B. $\left[\frac{-\pi}{3}, \frac{-\pi}{6} \right]$

C. $\left[\frac{1}{2} - \frac{\pi}{3} \left(1 + \frac{\pi}{3} \right), \frac{\sqrt{3}}{2} - \frac{\pi}{6} \left(1 + \frac{\pi}{6} \right) \right]$

D. None of these

Answer: c



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6. If $f(x) = \frac{3x + 2}{5x - 3}$, then $f[f(x)]$ is equal to:

A. $-x$

B. x

C. 0

D. None of these

Answer: b

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7. If $f(x) = a^x$, then the false statement from the following is:

A. $f(-x) \cdot f(x) = 1$

B. $f(x+3) - 2f(x+2) + f(x+1) = (a-2)^2 f(x+1)$

C. $f(x+y) = f(x) \cdot f(y)$

D. $f(x) \div f(y) = f\left(\frac{x}{y}\right)$

Answer: b

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8. If $f(x) = 10x - 7$ and $(f \circ g)(x) = x$, then $g(x)$ is equal to:

A. $\frac{x+7}{10}$

B. $\frac{x - 7}{10}$

C. $\frac{1}{10x - 7}$

D. None of these

Answer: A



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9. If $f(x) = \cos(\log x)$, then $f(x^2)f(y^2) - \frac{1}{2} \left[f\left(\frac{x^2}{y^2}\right) + f(x^2y^2) \right]$ has the value

A. $\frac{1}{2}$

B. -1

C. -2

D. None of these

Answer: d

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10. If $f(x) = \log\left(\frac{1+x}{1-x}\right)$ and $g(x) = \left(\frac{3x+x^3}{1+3x^2}\right)$, then $f(g(x))$ is equal to

A. $-f(x)$

B. $3f(x)$

C. $[f(x)]^2$

D. None of these

Answer: B

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Exercise 2 1

1. 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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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. Find whether the following statements are true or false. If the statement is false, then write its correct statement:

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

(ii) If A and B are non-empty sets, then $A \times B$ is a non-empty set of the ordered pairs (x,y) such that $x \in A$ and $y \in B$.

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5. If $A = \{(-1,), 1)\}$ find $A \times A \times A$.

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

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7. 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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8. 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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9. 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, z are distinct elements.

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10. 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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Exercise 2 2

1. Let $A = \{1, 2, 3, 14\}$. Define a relation on a set A by $R = \{(x, y) : 3x - y = 0, \text{ where } x, y \in A\}$. Depict this relationship using an arrow diagram. Write down its domain, co-domain and range.

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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.

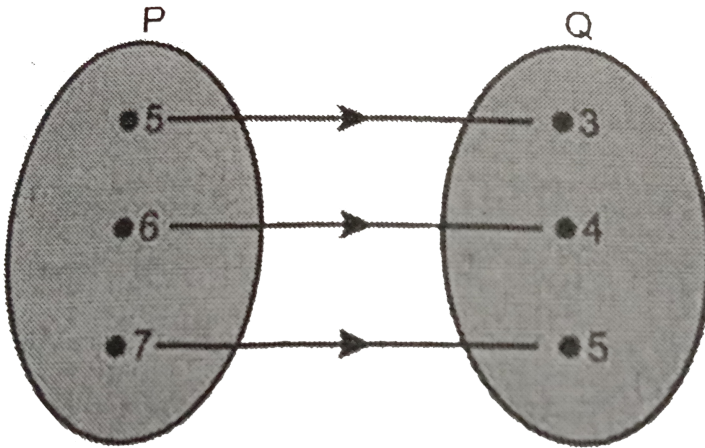
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3. $A = \{1, 2, 3, 5\}$ and $B = \{4, 6, 9\}$ A relation R is defined from A to B by $R = \{(x, y) : \text{the difference between } x \text{ \& } y \text{ is odd}\}$. Write R in roster form.

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4. The figure shows a relationship between the sets P and Q . Write this relation :
(i) in set-builder form

(ii) Roaster from. What is its domain and range?



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

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



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



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



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Exercise 2 3

1. Which of the following relations are functions? Give reasons. If it is a function, determine its domain and range.

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

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

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



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

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

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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)

$$f(x) = 2 + 3x, \quad x \in R, x > 0 \quad \text{(ii)}$$

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

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Miscellaneous Exercise

1. The relation f is defined by $f(x) = \begin{cases} x^2, & 0 \leq x \leq 3 \\ 3x, & 3 \leq x \leq 10 \end{cases}$ 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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2. If $f(x) = x^2$, find $\frac{f(1.1) - f(1)}{(1.1 - 1)}$

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

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

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

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

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

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

Determine the range of f .

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

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

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9. 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)

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

$(a,$



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10. If $A = \{1, 2, 3, 4\}$, $B = \{1, 5, 9, 11, 15, 16\}$ and

$f = \{(1, 5), (2, 9), (3, 1), (4, 5), (2, 11)\}$ are the following

statements true ?

(i) f is a relation from A to B .

(ii) f is a function from A to B

Justify your answer.



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11. 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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12. 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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