MATHS

BOOKS - BETTER CHOICE PUBLICATION

RELATIONS AND FUNCTIONS

Solved Examples Section I Multiple Choice Question

1. In a relation $R = \{a, b) : b - a = 2, b > 6\}$ then (a) $(2, 4) \in R$, (b) $(3, 8) \in R$, (c) $(6, 8) \in R$, (d) $(8, 7) \in R$.

A. $(2, 4) \in R$

B. $(3, 8) \in R$

C. $(6, 8) \in R$

D. $(8, 7) \in R$

Answer: C

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2. Let A = {1, 2, 3}, then the number of equivalence relations containing (1,2) is (a) 1 (b) 2 (c) 3 (d) 4 .

A. 1

B. 2

C. 3

D. 4

Answer: B

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3. Let $f: R - R$ be defined as $f(x) = x^4$, then

(a) f is one-one (b) f is many-one onto (c) f is

one-one but not onto (d) f is neither one-one nor onto

A. f is one-one

B. f is many-one onto

C. f is one-one but not onto

D. f is neither one-one nor onto

Answer: D

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4. If $f: R \to R$ be given by $f(x) = \left(3 - x^3\right)^{1/3}$, then (fof) (x) is

A. $x^{\frac{1}{3}}$

B. x^3

C. x

D. $3 - x^3$

Answer: C

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5. If f(x) = 3x + 5, where $f: R \to R$, then its inverse function $f^{-1}(x)$ is given by

A. $3x + 5$

B. $\frac{1}{3x + 5}$

C. $\frac{x - 5}{3}$

D. None of these

Answer: C

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6. Let $a * b = 2a + b$ be a binary operation then find $3 * 4$.

A. 7

B. 9

C. 10

D. None of these

Answer: C

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7. Number of binary operations on the set {a, b} is

A. 4

B. 8

C. 16

D. 20

Answer: C

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8. If $a * b = \frac{a}{a+b}$ defined on rational number Q then find the value of $2 * 3$.

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

B. $\frac{2}{5}$

C. $\frac{3}{5}$

D. None of these

Answer: B

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Solved Examples Section Ii Short Answer Type Questions

1. Show that the relation R in the set {1, 2, 3} defined as R = {(1, 1), (2, 2), (3, 3), (1, 2), (2, 3)} is reflexive, but neither symmetric nor transitive.

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2. Show that the relation R in the set R of real number defined by R = {(a, b) : $a \leq b$ }, is reflexive and transitive but not symmetric.

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3. Give an example of a relation which is reflextive and symmetric but not transitive.

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4. Determine whether the following relation is reflexive, symmetric and transitive :

Relation R in the set N of natural numbers, defined as

$R = (x, y) : y = x + 5 \text{ and } x < 4)$

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5. Let L be the set of all lines in XY plane and R be the relation in L defined as $R = \{(L_1, L_2) : L_1$ is parallel to L_2 $)\}$. Show that R is an equivalence relation. Find the set of all lines related to the line y = 2x + 4.

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6. Prove that the following relation R in Z of integers is an equivalence relation R = {(x, y): x-y

is an integer}

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7. Show that relation R in Z of integers given by R = {x,y} : x - y is divisible by 5, x , $y \in Z$ } is an equivalence relation.

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8. Check whether the relation R defined in the set (1, 2, 3, 4, 5, 6) as R= {(a, b) : b = a +1)} is

reflexive, symmetric or transitive ?

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9. Check whether the relation R in R, defined by $R = \{(a, b) : a \leq b^3\}$ is reflexive, symmetric or transitive ?

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Solved Examples Section Iii

1. Show that the function f: $N \to N$ given by f(x)= 3x is one-one but not onto.

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2. Check the injectivity and subjectivity for the function.

$f: R \to R$ given by $f(x) = x^2$

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3. Check the injectivity and surjectivity for the function

$f: N \to N$ given by $f(x) = x^3$

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4. Let A = {1, 2, 3}, B = {4, 5, 6, 7} and let f = {(1, 4), (2, 5), (3, 6)} be a function from A to B. Show that f is one-one.

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5. Show that the function $f: N \to N$ given by f(1) = f(2) = 1 and $f(x) = x - 1 \forall x > 2$ is onto but not one-one.

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6. Let a function $f: R \to R$ be defined by $f(x) = 3 - 4x$

Prove that f is one-one and onto.

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7. If $f(x) = \log\left(\frac{1-x}{1+x}\right) - 1 < x < 1$ then show that $f(-x) = -f(x)$

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Solved Examples Section Iv

1. If f ,$g: R \to R$ are defined respectively by $f(x) = \sqrt{1-x^2}, g(x) = \log x$ then find fog and gof.

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2. Let $f: R \to R$ and $g: R \to R$ be defined by $f(x) = x^2$ and $g(x) = x + 1$. show that gof is not equal to fog .

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3. Find fog and gof if

$f(x) = 8x^3$ and $g(x) = x^{1/3}$

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4. Find gof and fog if $f: R \to R$ and $g: R \to R$ are given by

f(x) = cos x and g (x) $= 3x^2$

Show that $gof \neq fog$

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5. Let f be the greatest integer function and g be the modulus function, then evaluate : gof(-7/3) - fog(-7/3) .

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6. If $f(x) = \frac{3x+2}{4x-3}, x \neq \frac{3}{4}$, then show that (fof) (x) = $x \forall x \neq \frac{3}{4}$

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

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Solved Examples Section V

1. If: $f: R \to R$ defined by $f(x) = \frac{2x+3}{4}$ is an invertible function, find f^{-1}

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2. If $f(x) = \frac{x-1}{x+2}$ invertible in its domain, if so, find f^{-1} Further verify that $\left(fof^{-1}\right)(x) = x$

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3. Show that $f: [-1, 1] \to R$, given by $f(x) = \frac{x}{x+2}$ is one-one. Find the inverse of

the function f: [-1,1] $\rightarrow$ Range f.

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4. Consider $f: R \rightarrow [-5, \infty]$ given by $f(x) = 9x^2 + 6x - 5$. Show that f is invertible with $f^{-1}(y) = \left[\frac{\sqrt{y+6} - 1}{3}\right]$

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5. The function $f: R \rightarrow R$ given by f(x) = 4x + 3. Show that f is invertible. Find the inverse of 'f'.

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6. For binary operation $*$ defined below, determine whether $*$ is commutative or associative ?

On Z, define $a * b = a - b$

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7. For binary operation $*$ defined below, determine whether $*$ is commutative or

associative ?

On Q , define $a * b = \frac{ab}{2}$

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8. For binary operation $*$ defined below, determine whether $*$ is commutative or associative ?

On Z^+ define $a * b = 2^{ab}$

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9. For the binary operation defined below, determine whether $*$ is commutative or associative On Q, define a*b = ab+1 .

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Assignment Most Important Questions For Practice Section I Multiple Choice Questions

1. Let A = {1, 2, 3}, then number of relations containing (1, 2) and (1, 3) which are reflexive and

symmetric but not transitive is (a) 1, (b) 2, (c) 3, (d) 4 .

A. 16

B. 2

C. 3

D. 4

Answer: A

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2. Let the relation in the set {1, 2, 3, 4} given by R= {(1, 2), (2, 2), (1, 1), (4,4), (1, 3), (3, 3), (3, 2) then

(a)R is reflexive and symmetric but not transitive

(b)R is reflexive and transitive but not symmetric

(c)R is symmetric and transitive but not reflexive

(d)R is an equivalence relation

A. R is reflexive and symmetric but not transitive

B. R is reflexive and transitive but not symmetric

C. R is symmetric and transitive but not reflexive

D. R is an equivalence relation

Answer: B

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3. Let R be the relation on the set N of natural numbers given by

$R = \{(a, b) : a - b > 2, b > 3\}$ .then (a)

$(4, 1) \in R$ (b) $(5, 8) \in R$ (c) $(8, 7) \in R$ (d) $(10, 6) \in R$

A. $(4, 1) \in R$

B. $(5, 8) \in R$

C. $(8, 7) \in R$

D. $(10, 6) \in R$

Answer: D

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4. Let A be a finite set containing n distinct elements. The number of relations that can be defined from A to A is (a) 2^n (b) n^2 (c) 2^{n^2} (d) None of these

A. 2^n

B. n^2

C. 2^{n^2}

D. None of these

Answer: C

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5. Let A = {1, 2, 3}, which of the following is not an equivalence relation of A { (1 , 1) , (2 , 2) , (3 , 3) }

A. $\{(1, 1), (2, 2), (3, 3)\}$

B. $\{(1, 1), (2, 2), (3, 3), (1, 2), (2, 1)\}$

C. $\{(1, 1), (2, 2), (3, 3), (2, 3), (3, 2)\}$

D. None of these

Answer: D

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6. Let $f: R \to R$ be defined by

$$f(x) = \begin{cases} 2x & x > 3 \\ x^2 & 1 \leq x < 3 \\ 3x & x \leq 1 \end{cases}$$

Then $f(-1) + f(2) + f(4)$ is

A. 9

B. 14

C. 5

D. None of these

Answer: A

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7. Let $f: R \to R$ be defined f(x) = sin x and g: $R \to R$ be defined by $g(x) = x^2$, Find fog .

A. $x^2 \sin x$

B. $(\sin x)^2$

C. $\sin x^2$

D. $\frac{\sin x}{x^2}$

Answer: C

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8. If n(A) = 3 and n(B) = 4, then the number of injective mapping that can be defined from A to B (a)144 (b)12 (c)24 (d)64

A. 144

B. 12

C. 24

D. 64

Answer: C

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9. Let $f: R \to R$ defined by $f(x) = x^2 + 1$, then pre image of 17 and -3 respectively are

A. $\phi, \{4, -4\}$

B. $\{3, -3\}, \phi$

C. $\{4, -4\}, \phi$

D. $\{4, -4\}, \{2, -2\}$

Answer: C

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10. Let $f: R \to R$ be defined as f(x) = 2x for all $x \in N$, then f is

A. onto

B. invertille

C. one -one

D. None of these

Answer: D

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11. Let $f: R \to R$ be defined by $f(x) = 2x - 3$ then find $f^{-1}(x)$.

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

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

C. $\frac{x}{2} + 3$

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

Answer: A

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Assignment Most Important Questions For Practice Section Ii Short Answer Type Questions

1. State the reason for the relation R, in the set {1,2,3} given by R= {(1,2), (2, 1), not to be transitive.

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2. A relation R on A={1,2,3} given by R={1,2), (1, 2), (3, 3)} is not symmetric. Why?

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3. Given an example of relation which is

(i) Symmetric but neither reflexive nor transitive

(ii) Transitive but neither reflexive nor symmetric.

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4. Check whether the relation R in set A = {1, 2, 3 ..... 13, 14} defined as R = {(x, y):3x -y = 0} is reflexive, symmetric and transitive.

View Text Solution

5. Show that relation R defined by

R = {(a, b) : a - b is divisible by $3, a, b \in Z$ } is an equivalence relation.

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6. Show that the relation R defined by

$(a, b)R(c, d) \Rightarrow a + d = b + c$ in the set N is an equivalence relation.

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Assignment Most Important Questions For Practice Section Iii

1. Let A={1,2,3}, B.:= {4, 5, 6,7}, and f = {(1, 4), (2,5), (3, 6) be function from A to B state whether the function f is one-one or not.

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2. Prove that the function $f: N \to N$ defined by $f(x) = x^2 + x + 1$ is one -one but not onto.

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3. Show that the function $f: R \to R$ given by f(x)= ax + b where $a, b \in R, a \neq 0$ is a bijection.

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4. Show. that the function $f: R \to R$ defined by $f(x) = \frac{3x - 1}{3}, x \in R$ is one-one and onto function.

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5. Check the injectivity and surjectivity of the function

$f: Z \to Z$ given by $f(x) = x^3$

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6. If $f: R \to R$ defined by f (x) = $4x^3 + 7$, show that fis a bijection.

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7. If $f: R \to R$ defined by $f(x) = 2x^3 - 7$, show that fis a bijection.

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Assignment Most Important Questions For Practice Section Iv

1. If the function $f: R \to R$ given by $f(x) = x^2 + 3x + 1$ and $g: R \to R$ he given by $g(x) = 2x - 3$ find

fog

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2. If the function $f: R \to R$ given by $f(x) = x^2 + 3x + 1$ and $g: R \to R$ he given by $g(x) = 2x - 3$ find

gof

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3. If the function $f: R \to R$ given by $f(x) = x^2 + 2$ and $gR \to R$ be given by

$g(x) = \frac{x}{x-1}$ find

fog

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4. If the function $f: R \to R$ given by $f(x) = x^2 + 2$ and $gR \to R$ be given by $g(x) = \frac{x}{x-1}$ find

gof

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5. Let $f(x) = 2x^2$ and $g(x) = 3x - 4, x \in R$.

Find

fog

Watch Video Solution

6. Let $f(x) = 2x^2$ and $g(x) = 3x - 4, x \in R$.

Find

gog

Watch Video Solution

7. Let $f(x) = 2x^2$ and $g(x) = 3x - 4, x \in R$.

Find

fog

Watch Video Solution

8. Let $f(x) = 2x^2$ and $g(x) = 3x - 4, x \in R$.

Find

gof

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9. If $f(x) = x + 7$ and $g(x) = x - 7$, $x \in R$

find (fog) (7).

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10. Let f(x) = [x] and g(x) = |x| find

$$(fog)\left(-\frac{3}{2}\right) + (gof)\left(\frac{4}{3}\right)$$

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11. Let f(x) = [x] and g(x) = |x| find

$$(gof)\left(\frac{5}{4}\right) - (fog)\left(\frac{-5}{4}\right)$$

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12. Let f(x) = [x] and g(x) = |x| find

$$(fog)\left(\frac{5}{2}\right) - (gof)\left(\frac{-5}{2}\right)$$

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13. Let f(x) = [x] and g(x) = |x| find

$$(gof)\left(\frac{-5}{3}\right) - (fog)\left(\frac{-5}{3}\right)$$

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14. If $f: R \to R$ is defined by $f(x) = 3x + 2$, find f(f(x))

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15. If $f: R \to R$ is defined by $f(x) = x^2 - 3x + 2$, find f(f(x))

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Assignment Most Important Questions For Practice Section V

1. If $f: R \to R$ defined by $f(x) = \frac{3x + 5}{2}$ is an invertible, find f^{-1}.

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2. If the function $f: R \to R$ defined by f(x) = 3x – 4 is invertible, find f^{-1}

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3. Let A =R- {2} and B=R - {1}. If $fA \to B$ is a function defined by $f(x) = \frac{x-1}{x-2}$, show that f is one -one and onto, hence find f^{-1}

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4. Let A = R- {3} and B = R- {1}. If $f: A \to B$ is a function defined by $f(x) = \frac{x-2}{x-3}$ show that f is one -one and onto, hence find f^{-1}.

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5. Show that f: [-1, 1], given by $f(x) = \frac{x}{x+2}$ is one-one. Find the inverse of $[-1, 1] \to R_f$

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6. If $f(x) = \frac{4x+3}{6x-4}, x \neq \frac{2}{3}$, show that (fof) (x) = x for all $\neq \frac{2}{3}$. What is inverse of 'f' ?

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Assignment Most Important Questions For Practice Section Vi

1. A binary operation $*$ is defined on $R \times R$ by $(a, b) * (c, d) = (ac, bc + d)$, where a, b, c, d $\in R$. Find $(2, 3) * (1, -2)$.

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2. The binary operation $* : R \times R \to R$ is defined as $a * b = 2a + b$. Find $(2 * 3) * 4$

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3. Let $*$ be a binary operation defined by $a * b = 2a + b - 3$ Find $3 * 4$.

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4. Let $*$ be binary operation on the set of of rational numbers given as $a * b = (2a - b)^2, a, b \in Q.$ Find $3 * 5$ and $5 * 3.$

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5. Let $*$ be a binary operation on N given by $a * b$= HCF (a, b), $a, b, \in N.$ Write the value of $22 * 4$.

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6. Let $*$ be a binary operation on the set of all non-zero real numbers, given by $a * b = \frac{ab}{5}$ for all $a, b \in R - \{0\}$. Find the value of x, given that $2 * (x * 5) = 10$

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7. For a binary operation $*$ on the set of rational numbers Q defined as $a * b = \frac{ab}{2}$ Determine whetler $*$ is

commutative

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8. For a binary operation $*$ on the set of rational numbers Q defined as $a * b = \frac{ab}{2}$ Determine whetler $*$ is

associative

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9. Let $*$ be binary operation on N defined by $a * b$ = HCF of a and b. Show that $*$ is both commutative and associative.

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10. Show that the operation $*$ on Q - {1} defined by $a * b = a + b - ab \forall a, b \in Q - \{1\}$ is commutative.

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11. Let $*$ be the binary operation on N given by $\cdot a \cdot b = L.C.M. of a \text{ and } b.$ Find : $5 \cdot 7$, $20 \cdot 16$

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12. Let $*$ be binary operation on N given by

$a * b$ = LCM of a and b. Find

Is $*$ commutative

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13. Let $*$ be the binary operation on N given by

$\cdot a \cdot b = L.C.M.ofa$ and $b.$ Find : Is $*$

associative?

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14. Let $*$ be binary operation on N given by $a * b$ = LCM of a and b. Find

Find the identity of $*$ in N.

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15. Let $*$ be the binary operation on N given by $\cdot a \cdot b = L.C.M.ofa \text{ and } b.$ Find : Which elements of N are invertible for the operation $*$?

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Previous Years Board S Questions For Practice Multiple Choice Questions

1. Let $a * b = 2a + 3b$, $*$ be a binary operation, then $3 * 2$ =

A. 5

B. 6

C. 12

D. None of these

Answer: C

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2. Let $a * b = 2a + b$, $*$ be a binary operation, then find $3 * 4$.

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3. Let $a * b = 3a + 2b$, $*$ be a binary operation, then $2 * 3$ =

A. 5

B. 6

C. 12

D. None of these

Answer: C

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4. If $a * b = a^{b-1}$, $*$ be binary operation, then find $1 * 3$.

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5. If $a * b = a^{b-1}$, $*$ be a binary operation, then find `4 * 3 .

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6. If $a \cdot b = a^{b-1}$, * be a Binary operation, then $3 \cdot 4$ is equal to :

A. 27

B. 12

C. 64

D. 81

Answer: A

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7. If $A = \{2, 3\}$, $B = \{2, 5\}$, then the total number of relations defined from A to B is :

A. 2^3

B. 2^2

C. 2^4

D. None of these

Answer: C

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8. If $f(x) = x^2 + 4$ is a function defined on $f: R \to [4, \infty)$, then its inverse function, defined as $f^{-1}(x)$, is:

A. $x^3 + 4$

B. $\frac{1}{x^2 + 4}$

C. $\sqrt{x - 4}$

D. None of these

Answer: C

Previous Years Board S Questions For Practice

1. Give an example of a relation which is symmetric and transitive but not reflexive.

2. Let f(x) = [x] and g(x) = |x| then find the value of

$$(fog)\left(\frac{1}{2}\right) - (gof)\left(\frac{1}{2}\right)$$

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3. Let f(x) = [x] and g(x) = |x| then find the value of

$$(gof)\left(\frac{5}{3}\right) - (fog)\left(\frac{5}{3}\right)$$

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4. If $f, g: R \to R$ are defined by $f(x) = x^2 + 3x + 1, g(x) = 2x - 3$ then find fog .

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5. If $f, g: R \to R$ are defined by $f(x) = x^2 + 3x + 1, g(x) = 2x - 3$ then find gof .

Watch Video Solution

6. If $f, g: R \to R$ are defined respectively by : $f(x) = x^2 + 3x + 1$, g (x) = 2x- 3`. Find fog and gof.

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7. If $f, g: R \to R$ are defined respectively by : $f(x) = x^2 + 3x + 1$, g (x) = 2x- 3`. Find fog and gof.

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8. Show that the relation R in the set {1, 2, 3} given by R= {(1, 2), (2, 1)} is symmetric but neither reflexive nor transitive.

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9. Give an example of a relation which is reflexive and transitive but not symmetric.

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10. Show that the relation R in the set {1,2,3} defined as R={(1,3), (3, 2), (1, 2)} is transitive but neither reflexive nor symmetric.

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11. If R is the relation 'less than' for:

$A = \{2, 4, 6, 8, 10\}$ to $B = \{8, 10, 12\}$,

write the elements corresponding to R.

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12. If R is the relation " greater than" for :

A = {1, 4, 5,} to B={1,2,4,5,6,7}, write down the elements corresponding to R.

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13. Show that the function $f: N \to N$ given by f(x) = 4x is one-one, but not onto.

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14. Show that the function $f: N \to N$ given by f(x) = 5x is one-one but not onto.

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15. Find fog and gof , if $f(x) = x^2, g(x) = x + 1$

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16. If $f: R \to R$ defined by $f(x) = \frac{5x + 6}{7}$ is an invertible function, find f^{-1}.

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17. Prove that the relation R in Z of integers given by: $R = \{(x, y) : 2x - 2y$ is an integer $\}$ is an equivalence relation. [3] If $f : R \to R$ defined by $f(x) = \dfrac{4 - 3x}{5}$ is an invertible function, find f^{-1}.

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18. Prove that the relation R in Z of integers given by: $R = \{(x, y) : 3x - 3y$ is an integer $\}$ is

an equivalence relation. [3] If $f: R \to R$ defined by $f(x) = \frac{6 - 5x}{7}$ is an invertible function, find f^{-1}.

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19. Show that the relation R defined by $R = \{(a, b)(a - b)$, is divisible by 5, `a, b in N} is an equivalence relation.

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20. Check the injectivity and surjectivity of the following function: $f: N \to N$ given by $f(x) = x^2$

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21. Check the injectivity and surjectivity of the following function: $f: Z \to Z$ given by $f(x) = x^2$

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22. If $f(x) = \frac{x}{x-1}$ then show that (fof)(x) = x.

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23. If f:(1,3,4} $\rightarrow$ {1, 2,5} and g:(1,2,5) {1,3} be given by f = {(1, 2), (3,5),(4, 1)} and g: {(1,3), (2, 3), (5, 1)}, write down gof.

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24. If $f: R \rightarrow R$ defined by : $f(x) = \frac{3-2x}{4}$ is an inversible function, find f^{-1}.

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25. If $f: R \to R$ defined by : $f(x) = \frac{6 - 5x}{7}$ is an inversible function, find f^{-1}.

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26. Prove that the relation R in Z of integers given by: $R = \{(x, y) : 2x - 2y$ is an integer $\}$ is an equivalence relation. [3] If $f: R \to R$ defined by $f(x) = \frac{4 - 3x}{5}$ is an invertible function, find f^{-1}.

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27. Let $f: N \to Y, be a function def \in edas f(x) = 4x + 3$, where, $Y = \{y \in N: y = 4x + 3$ for some $x \in N\}$. Show that f is invertible. Find the inverse.

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28. In a binary operation $* : \phi \times \phi \to \phi$ is defined as $a * b = \frac{ab}{4}, a, b \in \phi$. Show that $*$

is associative.

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29. If f(x) = 4x – 1 and $g(x) = x^3 + 2$, find

gof

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30. If f(x) = 4x – 1 and $g(x) = x^3 + 2$, find

gof

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31. If f(x) = sin x and g(x) = 2x, find fog.

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32. Is $f(x) = \frac{x-1}{x+1}$ invertible in its domain ? If so find, f^{-1} Further verify that $\left(fof^{-1}\right)(x) = x.$

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33. Consider $f: R^{+} \rightarrow [-5, \infty]$ given by $f(x) = 9x^2 + 6x - 5$ show that 'f' is invertible. Find the inverse of f.

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34. If $a * b = \frac{a}{2} + \frac{b}{3}$ then find value of $2 * 3$.

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35. Show that the relation R in the set R of real number defined as R = $\{(a, b): a \leq b^2\}$ is

neither reflexive nor symmetric nor transitive.

36. If R is the relation 'lessthan from A={1,2,3,4,5} to B={1,4,5}. Write down the cartesion product corresponding to R. Also find the inverse relation to R.

37. If R is the relation 'less than' from set A = {1, 2, 3, 4, 5} to B = {1,4,6}. Write down the cartesian product corresponding to R. Also find inverse relation to R.

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38. Show that $R = \{(a, b) : a \geq b\}$ is reflexive and transitive but not symmetric.

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39. If $f(x) = [x], g(x) = |x|$, then find the value of $(fog)\left(\frac{5}{2}\right) - (gof)\left(-\frac{5}{2}\right)$

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40. If $f: R \to R$ is defined by $f(x) = x^2 - 3x + 2$, find f(f(x))

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41. Find gof and fog if :

$f(x) = |x|$ and $g(x) = (5x - 2)$

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42. Show that relation R in Z of integers given by

R = {x,y} : x - y is divisible by 5, x , $y \in Z$ } is an

equivalence relation.

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43. Show that f: $R \to R$ defined by $f(x) = \frac{4x-3}{5}, \mathrm{x} \in R$ is invertible function and find f^{-1}.

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