Solutions of WORKSHEET No: 2

Topic : .... Date. : .... Page No. : ....

Solutions : worksheet No: 2 (1)

Relation & functions

Ans 1 → $A = \{-1, 0, 2, 4\}$

$f(x) = x^2 + 1$

$f(-1) = 1 + 1 = 2$
$f(0) = 0 + 1 = 1$
$f(2) = 4 + 1 = 5$
$f(4) = 16 + 1 = 17$

$\therefore$ Range of $f = \{2, 1, 5, 17\}$
$f = \{(-1, 2), (0, 1) (2, 5), (4, 17)\}$

for preimage of 3 put $f(x) = 3$
$\Rightarrow x^2 + 1 = 3$
$\Rightarrow x^2 = 2$
$\Rightarrow x = \pm\sqrt{2} \notin A$
$\therefore$ there is no preimage of 3 Ans

Ans 2 → given $f(x) = g(x)$
$\Rightarrow 2x^2 - 1 = 1 - 3x$
$\Rightarrow 2x^2 + 3x - 2 = 0$
$\Rightarrow 2x^2 + 4x - x - 2 = 0$
$\Rightarrow 2x(x+2) - 1(x+2) = 0$
$\Rightarrow (2x-1)(x+2) = 0$
$\Rightarrow x = 1/2 \; ; \; x = -2$
$\therefore$ Required domain is $\{\frac{1}{2}, -2\}$ Ans

Ans 3 → $f(x) = x^2 - 1$ and $g(x) = 2x + 3$
(1) $(f+g)(x) = f(x) + g(x) = x^2 - 1 + 2x + 3 \Rightarrow x^2 + 2x + 2$
(2) $(f-g)(x) = f(x) - g(x) = x^2 - 1 - 2x - 3 = x^2 - 2x - 4$

CLASSTIME

Solution of Worksheet No. 2

(3) $(fg)(x) = f(x)\,g(x) = (x^2-1)(2x+3) = 2x^3+3x^2-2x-3$

(4) $\left(\frac{f}{g}\right)(x) = \frac{f(x)}{g(x)} = \frac{x^2-1}{2x+3}$; $x \neq -3/2$

Ans 4 → $g = \{(3,5), (2,3), (1,1), (4,7)\}$

$g(x) = \alpha x + \beta$

$(3,5) \in g$

here $x = 3$ and $g(x) = 5$

$\therefore\ 5 = 3\alpha + \beta$ ---(1)

$(2,3) \in g$

here $x = 2$ and $g(x) = 3$

$\therefore\ 3 = 2\alpha + \beta$ -(2)

(1) - (2)

$2 = \alpha \Rightarrow 5 = 6 + \beta \Rightarrow \beta = -1$

$\therefore g(x) = 2x - 1$ Ans

Ans 5 → (i) $\{(x,y) : y = 3x\ ;\ x \in \{1,2,3\},\ y \in \{3,6,9,12\}\}$

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

It is a function because every element in domain has unique image in codomain.

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

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

It is not a function because element 1 has two different images 4 & 6

Solution of worksheet No:- 2

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

$R = \{(0,3)\,(3,0)\,(1,2)\,(2,1)\}$

It is a function because every element in domain has unique image in codomain. ANS

Qn. 6 → $A = \{12, 13, 14, 15, 16, 17\}$

$f(x)$ = highest prime factor of x

$f(12)$ = highest prime factor of 12 = 3

$f(13)$ = " " " " 13 = 13

$f(14)$ = " " " " 14 = 7

$f(15)$ = " " " " 15 = 5

$f(16)$ = " " " = 16 = 2

$f(17)$ " " " " 17 = 17

∴ Range of $f = \{3, 13, 7, 5, 2, 17\}$ ANS

Qn 7 → $f(x) = x^2$

$f(1.1) = (1.1)^2 = 1.21$

$f(1) = (1)^2 = 1$

Now $\dfrac{f(1.1) - f(1)}{1.1 - 1} = \dfrac{1.21 - 1}{0.1} = \dfrac{0.21}{0.1} = 2.1$ ANS

Qn. 8 → (i) $f(x) = \dfrac{x-1}{x+2}$

$f(x)$ is real for all values of x such that

$x+2 \neq 0 \Rightarrow x \neq -2$ ∴ Domain $= R - \{-2\}$ Ans

Topic : Relation and Function Date: Page No. :

Solution of Worksheet No: 2

(4)

(ii) $f(x) = \dfrac{x^2+3x+5}{x^2-5x+4}$

f(x) is real for all values of x such that

$x^2 - 5x + 4 \neq 0$

$(x-4)(x-1) \neq 0$

$x \neq 4 \; ; \; x \neq 1$

$\therefore$ Domain = $R - \{1, 4\}$ Ans

(iii) $f(x) = \dfrac{3x-1}{x^2-2}$

f(x) is real for all values of x such that

$x^2 - 2 \neq 0$

$(x+\sqrt{2})(x-\sqrt{2}) \neq 0$

$x \neq -\sqrt{2} \; ; \; x \neq \sqrt{2}$

$\therefore$ Domain = $R - \{-\sqrt{2}, \sqrt{2}\}$ Ans

(4) $f(x) = \dfrac{1}{x^2+2}$

f(x) is real for all values of x such that

$x^2 + 2 \neq 0$

$\therefore$ Domain = R Ans $\{$ there is no value of x for which $x^2+2=0\}$

(5) $f(x) = \sqrt{4x-3}$

f(x) is real for all values of x such that

$4x - 3 \geq 0$

$x \geq 3/4$

$\therefore$ Domain $x \in \left[\frac{3}{4}, \infty\right)$ Ans

CLASSTIME

Relation and function

Topic : .... Date. : .... Page No. : .... Page 5

Solution of worksheet No- 2

(6) $f(x) = \frac{1}{\sqrt{3x-2}}$

$f(x)$ is real for all values of x such that

$3x-2 > 0$

$\Rightarrow x > 2/3$

$\therefore$ Domain $x \in \left(\frac{2}{3}, \infty\right)$ Ans

(7) $f(x) = \frac{1}{\sqrt{3-2x}}$

$f(x)$ is real for all values of x such that

$3-2x > 0$

$2x-3 < 0$

$x < 3/2$ $\therefore$ Domain $x \in (-\infty, 3/2)$ Ans

(8) $f(x) = \sqrt{1-\sin(3x)}$

$f(x)$ is real for all values of x such that

$1-\sin(3x) \geq 0$

$\sin(3x) - 1 \leq 0$

$\sin(3x) \leq 1$ which is always true

since $-1 \leq \sin\theta \leq 1$

$\therefore$ Domain $= R$ Ans

(9) $f(x) = |x-2|$

$f(x)$ is real for all values of x such that

$x \in R$ since there is no value of x

for which $f(x)$ does not exists

$\therefore$ Domain $= R$ Ans

Relation & Function

Topic : .... Date. : .... Page No. : .... (6)

Solution of worksheet No: 2

(10) $f(x) = \frac{1}{|x-3|}$

$f(x)$ is real for all values of x such that $x-3 \neq 0$

$x \neq 3$

$\therefore$ Domain $= R - \{3\}$ Ans

(11) $f(x) = \frac{1}{|x|-2}$

$f(x)$ is real for all values of x such that

$|x| - 2 \neq 0$

$|x| \neq 2$

$x \neq \pm 2$ $\left\{ \text{Since } \begin{array}{l} |2| = 2 \\ |-2| = 2 \end{array} \right\}$

$\therefore$ Domain $= R - \{-2, 2\}$ Ans

(12) $f(x) = \frac{1}{1 - 2\sin x}$

$f(x)$ is real for all values of x such that

$1 - 2\sin x \neq 0$

$\sin x \neq 1/2$

$x \neq \pi/6$

$\therefore$ Domain $= R - \{\pi/6\}$ Ans

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