

Mathematics

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(Chapter – 1) (Relations and Functions)

(Class – XII)

Miscellaneous Exercises 1

Question 1:

Let $f: \mathbf{R} \rightarrow \mathbf{R}$ be defined as $f(x) = 10x + 7$. Find the function $g: \mathbf{R} \rightarrow \mathbf{R}$ such that $g \circ f = f \circ g = I_{\mathbf{R}}$.

Answer 1:

It is given that $f: \mathbf{R} \rightarrow \mathbf{R}$ is defined as $f(x) = 10x + 7$.

For one – one

Let $f(x) = f(y)$, where $x, y \in \mathbf{R}$.

$$\Rightarrow 10x + 7 = 10y + 7 \Rightarrow x = y$$

$\therefore f$ is a one – one function.

For onto

For $y \in \mathbf{R}$, let $y = 10x + 7$.

$$\Rightarrow x = \frac{y-7}{10} \in \mathbf{R}$$

Therefore, for any $y \in \mathbf{R}$, there exists $x = \frac{y-7}{10} \in \mathbf{R}$ such that

$$f(x) = f\left(\frac{y-7}{10}\right) = 10\left(\frac{y-7}{10}\right) + 7 = y - 7 + 7 = y$$

$\therefore f$ is onto.

Therefore, f is one – one and onto. Thus, f is an invertible function.

Let us define $g: \mathbf{R} \rightarrow \mathbf{R}$ as $g(y) = \frac{y-7}{10}$

Now, we have

$$g \circ f(x) = g(f(x)) = g(10x + 7) = \frac{(10x + 7) - 7}{10} = \frac{10x}{10} = x$$

and

$$f \circ g(y) = f(g(y)) = f\left(\frac{y-7}{10}\right) = 10\left(\frac{y-7}{10}\right) + 7 = y - 7 + 7 = y$$

$\therefore g \circ f = I_{\mathbf{R}}$ and $f \circ g = I_{\mathbf{R}}$.

Hence, the required function $g: \mathbf{R} \rightarrow \mathbf{R}$ is defined as $g(y) = \frac{y-7}{10}$.

Question 2:

Let $f: \mathbf{W} \rightarrow \mathbf{W}$ be defined as $f(n) = n - 1$, if n is odd and $f(n) = n + 1$, if n is even. Show that f is invertible. Find the inverse of f . Here, $\mathbf{W}$ is the set of all whole numbers.

Answer 2:

It is given that:

$$f: \mathbf{W} \rightarrow \mathbf{W} \text{ is defined as } f(n) = \begin{cases} n - 1, & \text{if } n \text{ is odd} \\ n + 1, & \text{if } n \text{ is even} \end{cases}$$

For one – one

Let $f(n) = f(m)$.

It can be observed that if n is odd and m is even, then we will have $n - 1 = m + 1$, $\Rightarrow n - m = 2$

However, this is impossible.

Similarly, the possibility of n being even and m being odd can also be ignored under a similar argument.

$\therefore$ Both n and m must be either odd or even. Now, if both n and m are odd,

$$\text{Then, we have, } f(n) = f(m) \Rightarrow n - 1 = m - 1 \Rightarrow n = m$$

Again, if both n and m are even,

$$\text{Then, we have, } f(n) = f(m) \Rightarrow n + 1 = m + 1 \Rightarrow n = m$$

$\therefore f$ is one – one.

For onto

It is clear that any odd number $2r + 1$ in co-domain $\mathbf{N}$ is the image of $2r$ in domain $\mathbf{N}$ and any even number $2r$ in co-domain $\mathbf{N}$ is the image of $2r + 1$ in domain $\mathbf{N}$.

$\therefore f$ is onto.

Hence, f is an invertible function.

12th Science Maths Notes

Minjie Lin

A red circular graphic with a gradient, appearing as a stylized arrow or a partial circle, located to the right of the author's name.

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