

UNIVERSITY PARTNER



4MM013 - Computational Mathematics

Mathematics Assignment-1

Full Marks: 10

University ID : 2331425

Submitted by : Eliza Gamal

Submitted on : 4/13/2023

1. State the definition of a function and a composite function.

[2Marks]

Let f and g be functions defined as follows:

$$f: \mathbb{R} \rightarrow \mathbb{R}, f(x) = \frac{x-3}{x+1}, f(2) = ? \text{ and}$$

$$g: \mathbb{R} \rightarrow \mathbb{R}, g(x) = \frac{1}{x}, x \neq 0$$

Calculate $(f \circ g)(x)$ and $(g \circ f)(x)$.

Ebra Gamal
2331425

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Q. no. 1.

1. State the definition of a function and a composite function.
Let f and g be function defined as follows:

$$f: \mathbb{R} \rightarrow \mathbb{R}, f(x) = \frac{x-3}{x+1}, f(2) = ? \text{ and}$$
$$g: \mathbb{R} \rightarrow \mathbb{R}, g(x) = \frac{1}{x}, x \neq 0$$

Calculate $(f \circ g)(x)$ and $(g \circ f)(x)$

Here,

Ans: A function is defined as a relation between a set of inputs having one output each. It is generally denoted by $f(x)$ where x is the input.
Composite function is a function that is written inside another function. Eg: $f(g(x))$ is the composite function of $f(x)$ and $g(x)$

Soln,

$$(f \circ g)(x) = f(g(x))$$
$$= \frac{1-3}{\frac{1}{x}+1} = \frac{1-3x}{\frac{1+x}{x}} = \frac{1-3x}{1+x} \cdot \frac{x}{x} = \frac{x(1-3x)}{1+x}$$

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

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$$g \circ f(x) = g(f(x))$$

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

$$x+1$$

$$= \frac{x+1}{x-3} \quad \text{Ans}$$

2. Solve the following using the inverse matrix method:

[2 Marks]

$$6x - y = 0$$

$$2x - 4y = 1$$

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Solve the following using inverse matrix method.

$$\begin{aligned} 6x - y &= 0 \\ 2x - 4y &= 1 \end{aligned}$$
$$\begin{bmatrix} 6 & -1 \\ 2 & -4 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$
$$A^{-1} = \frac{1}{|A|} \text{adj} A$$
$$= \frac{1}{ad-bc} \begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$$
$$= \frac{1}{6(-4) - (-1)2} \begin{bmatrix} -4 & 1 \\ -2 & 6 \end{bmatrix}$$
$$= \frac{1}{-22} \begin{bmatrix} -4 & 1 \\ -2 & 6 \end{bmatrix}$$
$$= \begin{bmatrix} \frac{2}{11} & -\frac{1}{22} \\ \frac{1}{11} & -\frac{3}{11} \end{bmatrix}$$
$$\begin{bmatrix} 6 & -1 \\ 2 & -4 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$
$$AX = B$$
$$A^{-1}AX = A^{-1}B$$
$$\therefore X = A^{-1}B$$

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$$\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 2/11 & -1/22 \\ 1/11 & -3/11 \end{bmatrix} \times \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

$$= \begin{bmatrix} -1/22 \\ -3/11 \end{bmatrix}$$

$$\therefore x = -\frac{1}{22}$$

$$\therefore y = -\frac{3}{11}$$

3. Calculate the inverse of the following functions:

[2 Marks]

a. $f(x) = \frac{6+x}{7}$

b. $f(x) = \frac{3}{2-x}$

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3. Calculate the inverse of the following functions;

a) $f(x) = \frac{6+x}{7}$

Solution,

Let $f(x) = y$

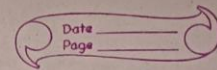
$$y = \frac{6+x}{7}$$

Interchanging the position of x and y

$$x = \frac{6+y}{7}$$

Eliza Gamal

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$$\text{or, } 7x = 6 + y$$

$$\therefore y = 7x - 6$$

$$\therefore f'(x) = 7x - 6$$

3.6) Ans,

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

$$\text{let } f(x) = y$$

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

Interchanging value of x & y

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

$$\text{or } 2x - xy = 3$$

$$\text{or } xy = 2x - 3$$

$$\text{or } y = \frac{2x-3}{x}$$

$$\therefore f^{-1}(x) = \frac{2x-3}{x}$$

4. Sketch the graph of the following functions:

[2 Marks]

$$f(x) = 2(x - 1)^2 + 3, \quad -2 < x < 2 \quad \text{In the interval of } x=0.5$$

Eliza Gamal
2331425

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4. Sketch the graph of the following functions:

$f(x) = 2(x-1)^2 + 3, \quad -2 < x < 2$. In the interval of $x=0.5$

Solution,

For sketching the graph of this function in interval of $x=0.5$ we need to evaluate $f(0.5)$ and plot the point $(0.5, f(0.5))$ and plot on the graph.

So, evaluating $f(0.5)$, we get,

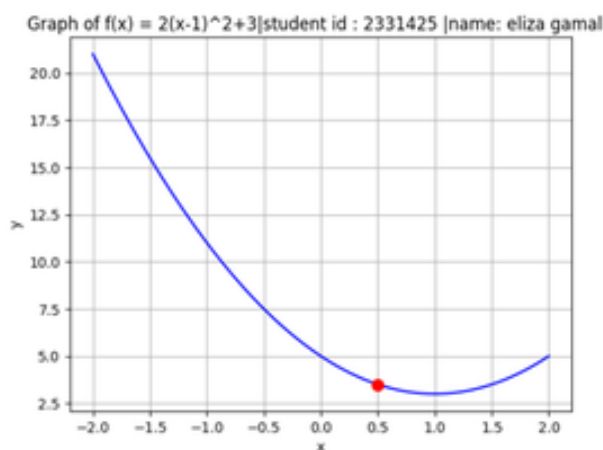
$$f(0.5) = 2(0.5-1)^2 + 3$$

$$= 2(0.25) + 3 = 3.5$$

\therefore The point to plot on the graph is $(0.5, 3.5)$

Here is the table:

x	$f(x)$
-2.0	21.0
-1.0	11.0
0.0	5.0
1.0	3.0
2.0	5
0.5	3.5



5.

a. Define gradient of a function. State the gradient and intercept of :

$$2y + 8 = 6x$$

[2 Marks]

b. Solve the following equations:

$$x^2 + \frac{17}{6}x + 2 = 0$$

Elixa Gamal
2851425

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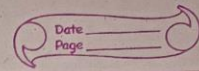
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Sol'n.

The gradient of a function is a measure of how steeply it changes with respect to its input variable for a function of two variable the gradient is a vector that point in the direction of maximum increase of function, and its magnitude respects the rate of change of function in direction.

Now,
For the gradient and intercept of
 $2y + 8 = 6x$
we compare it with $y = mx + b$
So,
 $y = \frac{6x - 8}{2}$
 $y = \frac{6x}{2} - \frac{8}{2}$
 $y = 3x - 4$

\therefore Comparing $y = 3x - 4$ with $y = mx + b$
we get,
 $m = 3$, $c = -4$
 \therefore The gradient is 3 and the intercept is -4

Efiza Gamal
23/1/25



$$x = \frac{-17+1}{\frac{6}{2}}$$

$$= \frac{-16}{12}$$

$$= -\frac{4}{3} \text{ Ans}$$

Secondly using (-)ve negative we get,

$$x = \frac{-17 - 1}{\frac{6}{2}}$$

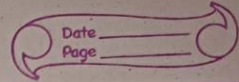
$$= \frac{-18}{6}$$

$$= -\frac{18}{12} = -\frac{3}{2}$$

\therefore The value of x is $-\frac{4}{3}$ and $-\frac{3}{2}$ Ans

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2331925



$$b) \quad x^2 + \frac{17}{6}x + 2 = 0$$

$$\text{or, } 6x^2 + 17x + 12 = 0$$

$$\text{or, } 6x^2 + 8x + 9x + 12 = 0$$

$$\text{or } 2x(3x+4) + 3(3x+4) = 0$$

$$(3x+4)(2x+3) = 0$$

Either,

$$3x+4 = 0 \text{ — i)}$$

$$2x+3 = 0 \text{ — ii)}$$

eqn i)

$$3x = -4$$

$$\therefore x = -\frac{4}{3}$$

eqn ii)

$$2x = -3$$

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

The End