UNIVERSITY PARTNER

UNIVERSITY OF WOLVERHAMPTON

HERALD COLLEGE KATHMANDU

4MM013 - Computational Mathematics

Mathematics Assignment-1

Full Marks: 10

University ID : 2332917

Submitted by : Niraj Chaudhary

Submitted on : Subash Khatiwada

1. State the definition of a function and a composite function. **[2Marks]**

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Q.No:-1

A function is defined as a relation between a set of inputs having one ~~input~~ output each. In simple words, a function has a domain and co-domain or range. A function is generally denoted by f(x) where x is the input. The general representation of a function is y(x).

Let f: A→B and g: B→C. The composition of f with g is a function from A into C defined by (gof)x = g[f(x)] and is denoted by gof.

To find the composite function of f and g, first find the image of x under f and then find the image of f(x) under g.

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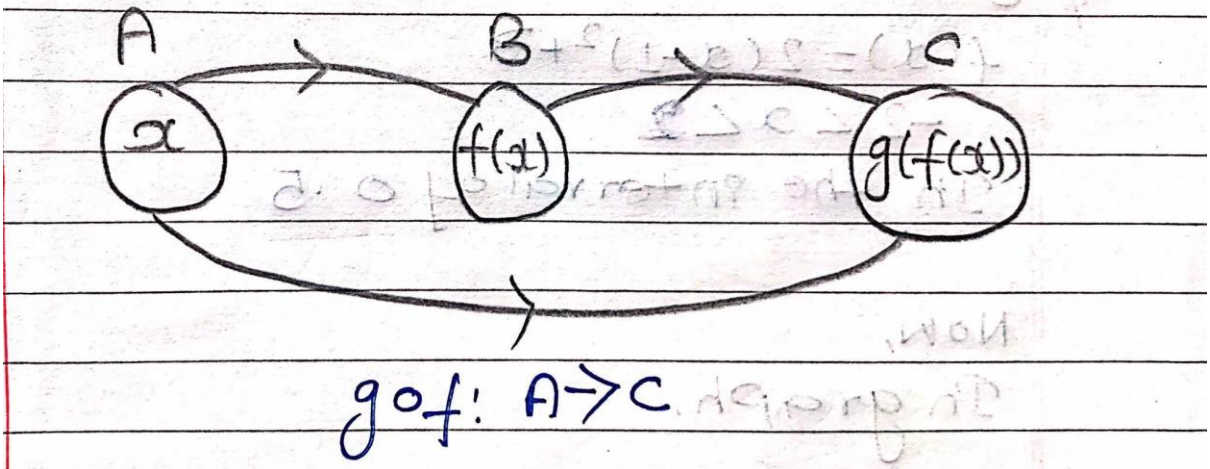

Let f and g be functions defined as follows:

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

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

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

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Q.No 1

Soln

Given,

$f: R \to R, f(x) = \frac{x-3}{x+1}$, $f(2) = ?$

Now,

$f(2) = \frac{2-3}{2+1} = \frac{-1}{3}$

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

$(fog)(x)$

$f(g(x))$

$f\left(\frac{1}{x}\right)$

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

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

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

$(fog)(x) = \frac{1-3x}{1+x}$ Ans//

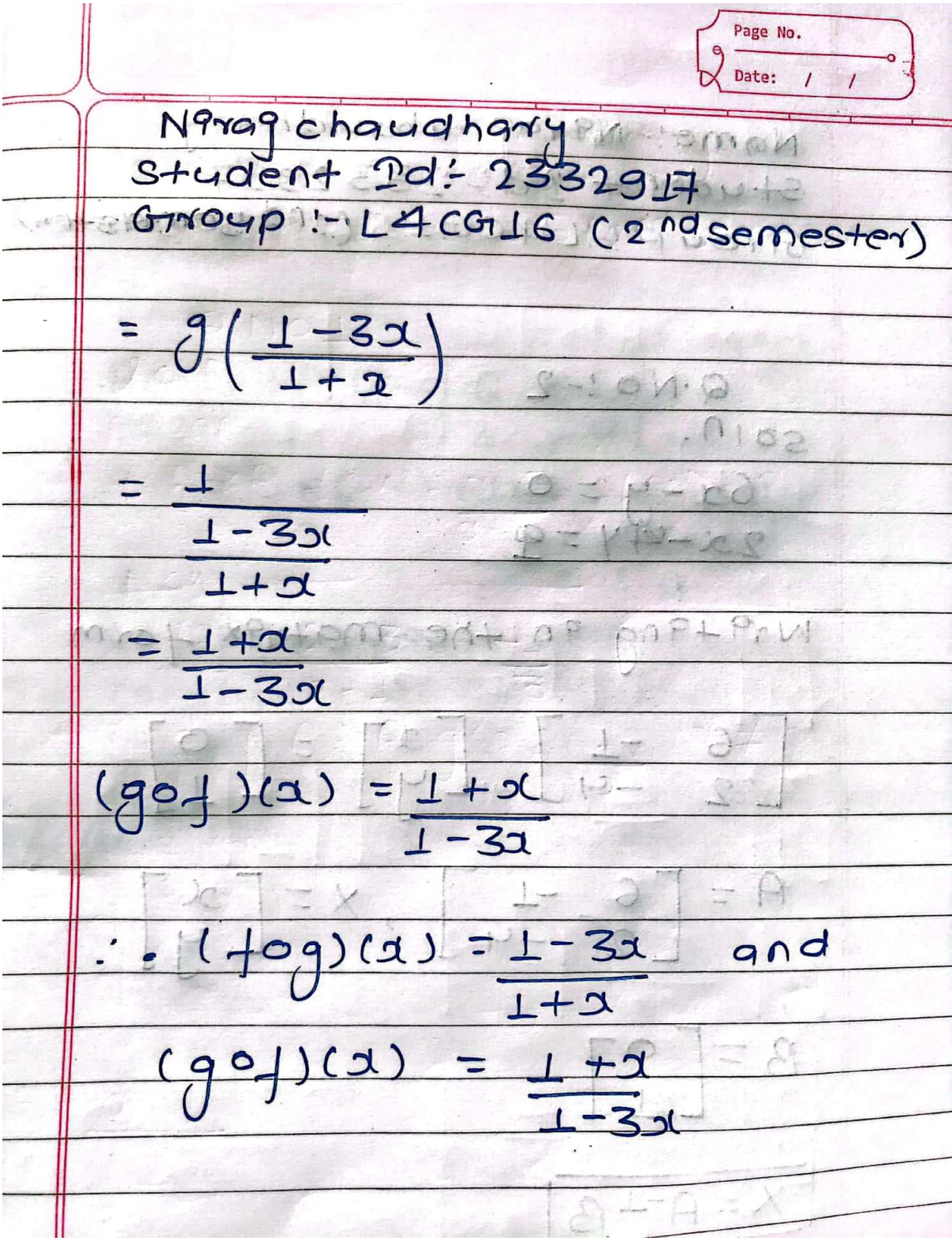
Again,

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

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

$(gof)(x)$

$g(f(x))$



2. Solve the following using the inverse matrix method: **[2 Marks]**

$$6x - y = 0$$

$$2x - 4y = 1$$

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Q.No:- 2

soln.

$$6x - y = 0$$
$$2x - 4y = 9$$

Writing in the matrix form

$$\begin{bmatrix} 6 & -1 \\ 2 & -4 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

$$A = \begin{bmatrix} 6 & -1 \\ 2 & -4 \end{bmatrix}, \quad X = \begin{bmatrix} x \\ y \end{bmatrix}$$

$$B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

$$\boxed{X = A^{-1}B}$$

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Here, $|A| = \begin{vmatrix} 6 & -1 \\ 2 & -4 \end{vmatrix}$

$= 6 \times (-4) + 1 \times 2 = -22$

And,

$X = A^{-1} B$

$\begin{bmatrix} x \\ y \end{bmatrix} = \frac{1}{|A|} \begin{pmatrix} d & -b \\ -c & a \end{pmatrix} \cdot B$

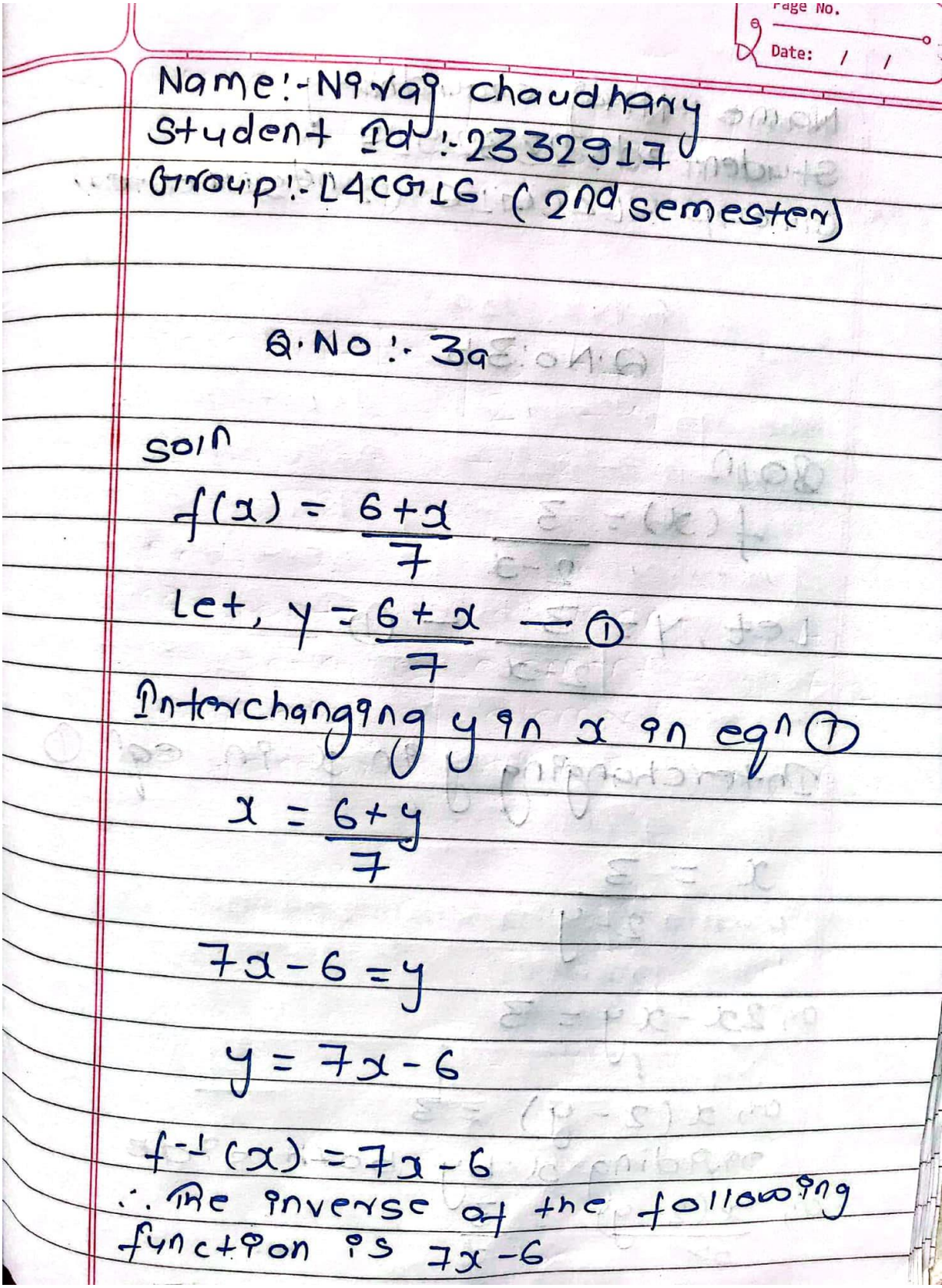
$\begin{bmatrix} x \\ y \end{bmatrix} = \frac{1}{-22} \begin{vmatrix} -4 & 1 \\ -2 & 6 \end{vmatrix} \cdot \begin{vmatrix} 0 \\ 1 \end{vmatrix}$

$\begin{bmatrix} x \\ y \end{bmatrix} = \frac{1}{-22} \begin{vmatrix} 1 \\ 6 \end{vmatrix}$

$\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} \frac{1}{-22} \\ \frac{-3}{11} \end{bmatrix}$

$\therefore x = \frac{1}{-22}, \quad y = \frac{-3}{11}$

3. Calculate the inverse of the following functions: **[2 Marks]**
   a. $f(x) = \frac{6+x}{7}$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Q.No:- 3a
soln
$f(x) = \frac{6+x}{7}$
Let, $y = \frac{6+x}{7}$ — ①
Interchanging y in x in eqn ①
$x = \frac{6+y}{7}$
$7x - 6 = y$
$y = 7x - 6$
$f^{-1}(x) = 7x - 6$
∴ The inverse of the following function is $7x - 6$

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

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Q.No:3b

Soln

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

Let, $y = \frac{3}{2-x}$ — (1)

Interchanging y in x in eqn (1)

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

or, $2x - xy = 3$

or, $x(2-y) = 3$

Dividing x by both side

or, $\frac{x(2-y)}{x} = \frac{3}{x}$

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

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

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

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

∴ The inverse of the following function is $\frac{2x-3}{x}$

4. Sketch the graph of the following functions: **[2 Marks]**

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

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Q.No :- 4

Q4 Soln.

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

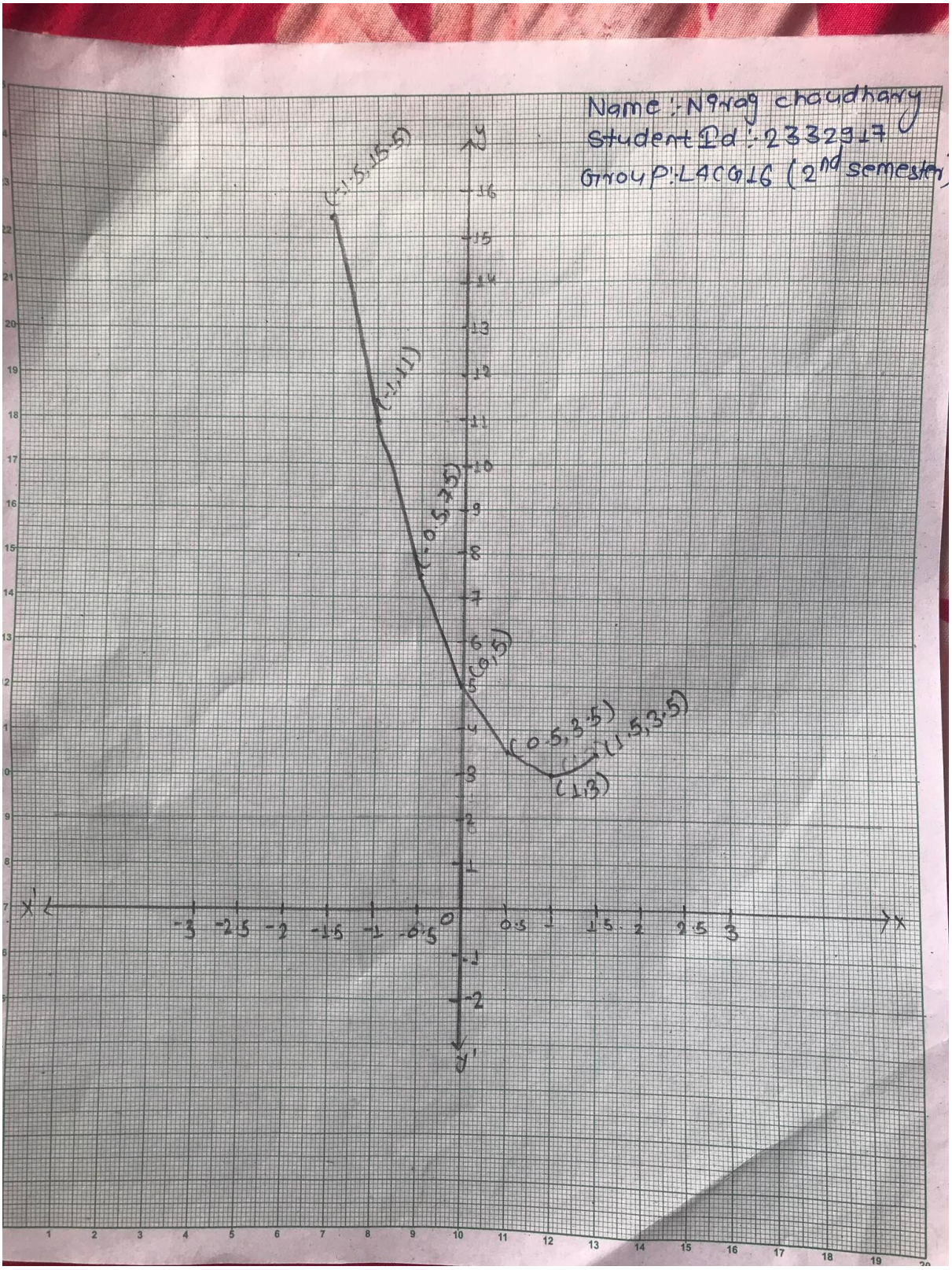
$-2 < x < 2$

In the interval of 0.5

Now,

In graph,

x	-1.5	-1	-0.5	0	0.5	1	1.5
y	15.5	11	7.5	5	3.5	3	3.5



5.

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

$2y + 8 = 6x$

[2 Marks]

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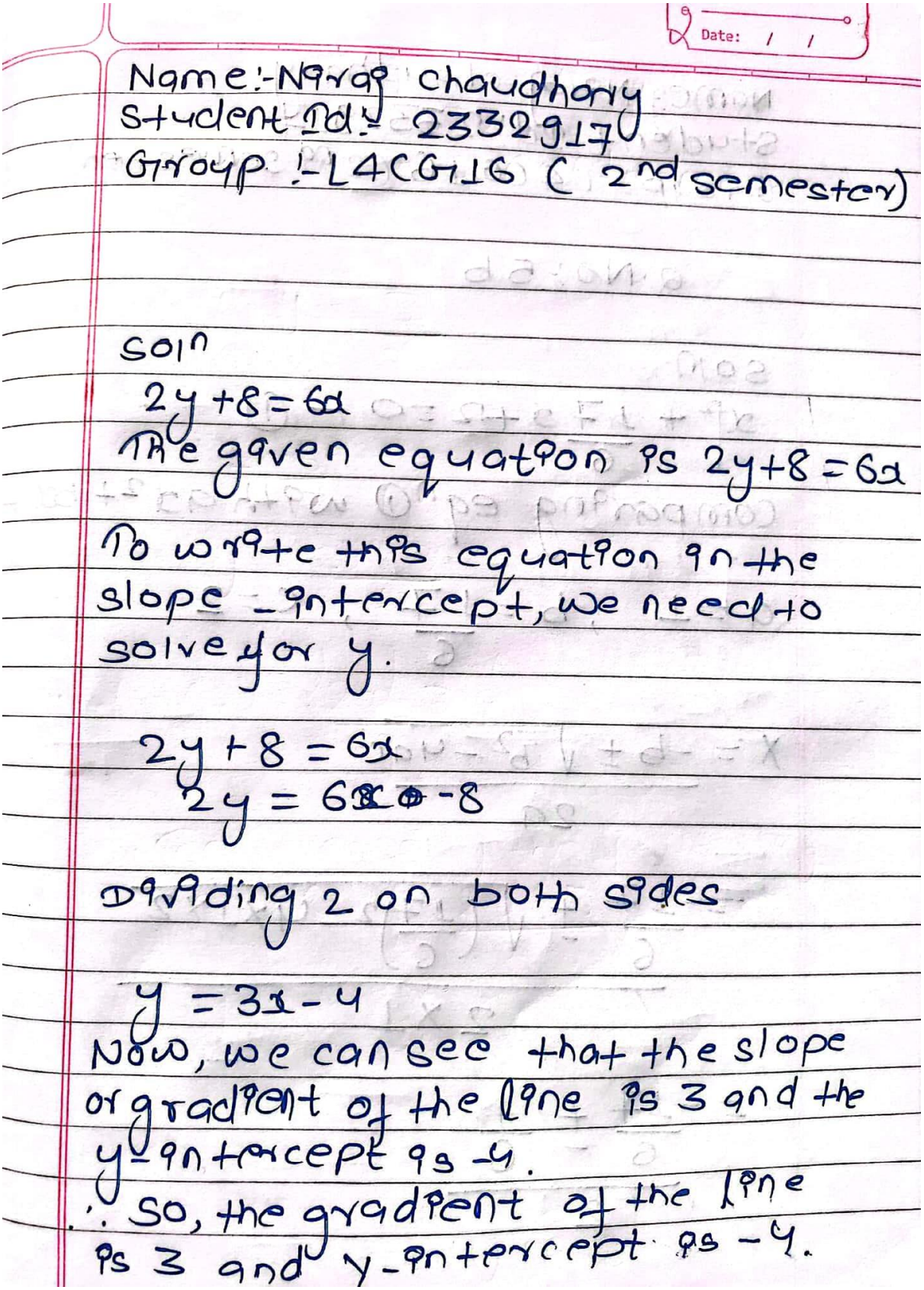
Q.No:- 5a

The gradient of a function is a mathematical concept that measures the rate of change of the function with respect to its input variables. It is a vector-valued function that gives the direction and magnitude of the steepest ascent of the function at a given point.

formally, for a function $f(x_1, x_2 \ldots x_n)$ the gradient is defined as:

$$\nabla f = \left(\frac{df}{dx_1}, \frac{df}{dx_2}, \ldots, \frac{df}{dx_n}\right)$$

where each component of the gradient vector represents the partial derivative of the function with respect to one of its input variable.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Soln

$2y + 8 = 6x$

The given equation is $2y + 8 = 6x$

To write this equation in the slope - intercept, we need to solve for y.

$2y + 8 = 6x$

$2y = 6x - 8$

Dividing 2 on both sides

$y = 3x - 4$

Now, we can see that the slope or gradient of the line is 3 and the y-intercept is -4.

∴ So, the gradient of the line is 3 and y-intercept is -4.

b. Solve the following equations:

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

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Q.No:- 5b

Soln

$$x^2 + \frac{17}{6}x + 2 = 0 \quad \text{— (1)}$$

Comparing eqn (1) with $ax^2 + bx + c$

$$a = 1, \quad b = \frac{17}{6}, \quad c = 2$$

$$X = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$= \frac{-\frac{17}{6} \pm \sqrt{\left(\frac{17}{6}\right)^2 - 4 \times 1 \times 2}}{2 \times 1}$$

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

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(+) sign

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

$$= \frac{\frac{-17+1}{63}}{21}$$

$$= \frac{-16}{3}$$

(-) sign

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

$$= \frac{\frac{-18}{63}}{21}$$

$$= -6$$

$\therefore X = \left(\frac{-16}{3}, -6\right)$

The End