

Chapter # 5

Linear Equations and Inequalities

Exercise # 5.1

Question # 1: Solve and represent the solution on a real line.

(i) $12x + 30 = -6$ _____ (A)

$$12x = -6 - 30$$

$$12x = -36$$

$$x = \frac{-36}{12}$$

$$x = -3$$

Check:

put $x = -3$ in equation (A)

$$12(-3) + 30 = -6$$

$$-36 + 30 = -6$$

$$-6 = -6$$

$$S.S = \{-3\}$$



(ii) $\frac{x}{3} + 6 = -12$ _____ (A)

$$\frac{x}{3} = -12 - 6$$

$$\frac{x}{3} = -18$$

$$x = -18 \times 3$$

$$x = -54$$

Check:

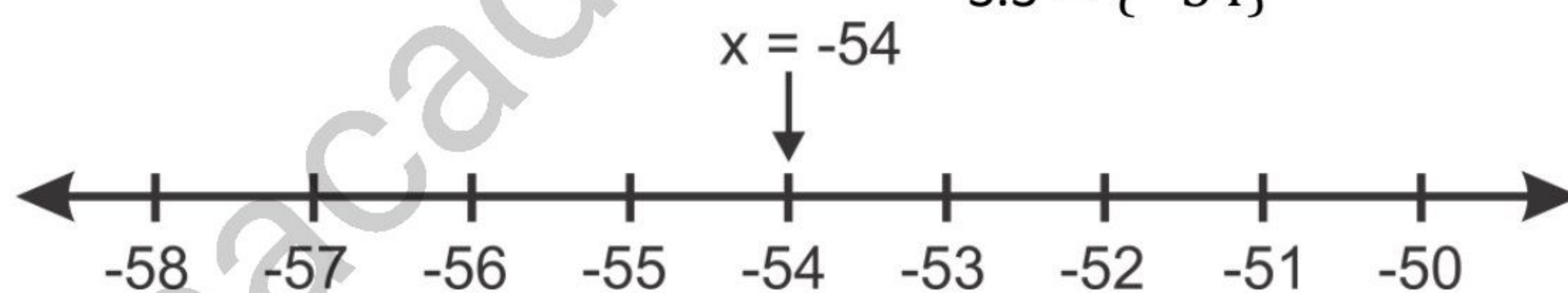
put $x = -54$ in equation (A)

$$\frac{-54}{3} + 6 = -12$$

$$\frac{-36}{3} = -12$$

$$-12 = -12$$

$$S.S = \{-54\}$$



(iii) $\frac{x}{2} - \frac{3x}{4} = \frac{1}{12}$ _____ (A)

Multiply by '12' on both sides

$$12 \times \frac{x}{2} - 12 \times \frac{3x}{4} = 12 \times \frac{1}{12}$$

$$6x - 9x = 1$$

$$-3x = 1$$

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

2	2,4,12
2	1,2,6
3	1,1,3
	1,1,1

Check:

put $x = -\frac{1}{3}$ in equation (A)

$$\frac{-\frac{1}{3}}{2} - \frac{3(-\frac{1}{3})}{4} = \frac{1}{12}$$

$$-\frac{1}{6} + \frac{1}{4} = \frac{1}{12}$$

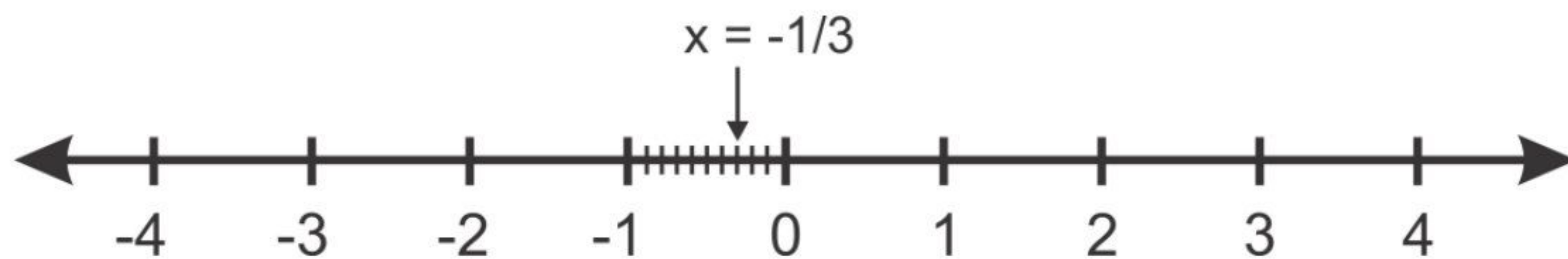
$$-\frac{1}{6} + \frac{1}{4} = \frac{1}{12}$$

$$\frac{-2+3}{12} = \frac{1}{12}$$

$$\frac{1}{12} = \frac{1}{12}$$

$$S.S = \{-\frac{1}{3}\}$$

2	6,4
2	3,2
3	3,1
	1,1



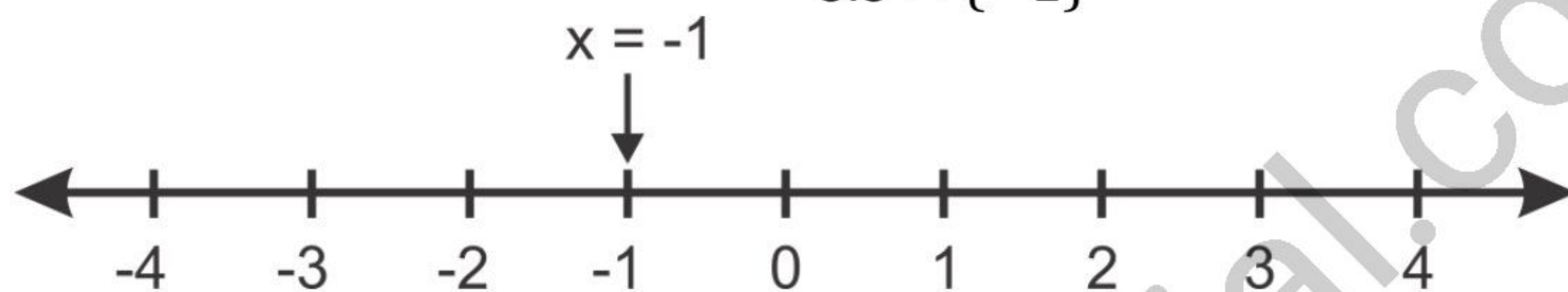
(iv) $2 = 7(2x + 4) + 12x$ _____ (A)

$$\begin{aligned} 2 &= 14x + 28 + 12x \\ 2 - 28 &= 26x \\ -26 &= 26x \\ \frac{-26}{26} &= x \\ x &= -1 \end{aligned}$$

Check:

put $x = -1$ in equation (A)

$$\begin{aligned} 2 &= 7[2(-1) + 4] + 12(-1) \\ 2 &= 7(-2 + 4) - 12 \\ 2 &= 7(2) - 12 \\ 2 &= 14 - 12 \\ 2 &= 2 \\ \text{S.S} &= \{-1\} \end{aligned}$$



(v) $\frac{2x-1}{3} - \frac{3x}{4} = \frac{5}{6}$ _____ (A)

Multiply by '12' on both sides

$$\begin{aligned} 12 \times \frac{2x-1}{3} - 12 \times \frac{3x}{4} &= 12 \times \frac{5}{6} \\ 4(2x-1) - 3 \times 3x &= 2 \times 5 \\ 8x - 4 - 9x &= 10 \\ 8x - 9x &= 10 + 4 \\ -x &= 14 \\ x &= -14 \end{aligned}$$

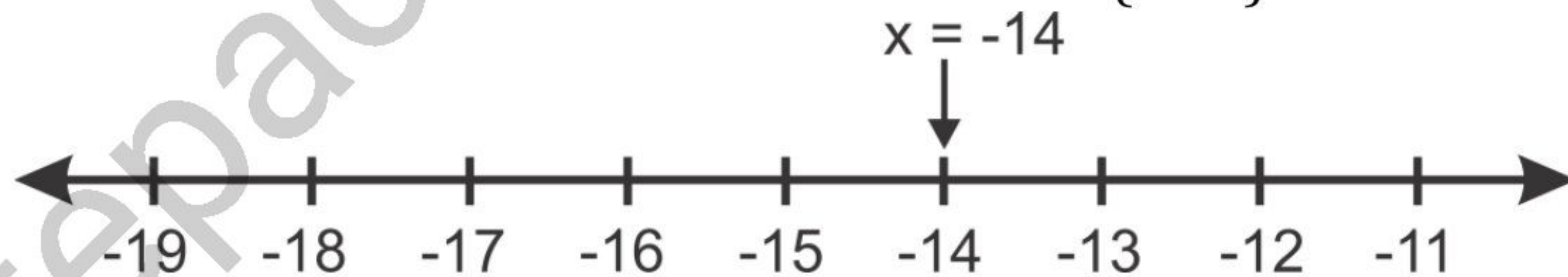
2	3,4,6
2	3,2,3
3	3,1,3
	1,1,1

Check:

put $x = -14$ in equation (A)

$$\begin{aligned} \frac{2(-14)-1}{3} - \frac{3(-14)}{4} &= \frac{5}{6} \\ \frac{-28-1}{3} + \frac{42}{4} &= \frac{5}{6} \\ \frac{-29}{3} + \frac{42}{4} &= \frac{5}{6} \\ \frac{-116+126}{12} &= \frac{5}{6} \\ \frac{10}{12} &= \frac{5}{6} \\ \frac{5}{6} &= \frac{5}{6} \end{aligned}$$

S.S = {-14}



(vi) $-\frac{5x}{10} = 9 - \frac{10}{5}x$ _____ (A)

Multiply by '10' on both sides

$$\begin{aligned} -\frac{5x}{10} \times 10 &= 9 \times 10 - \frac{10}{5}x \times 10 \\ -5x &= 90 - 20x \\ -5x + 20x &= 90 \\ 15x &= 90 \\ x &= \frac{90}{15} \\ x &= 6 \end{aligned}$$

2	10,5
5	5,5
	1,1

Check:

put $x = 6$ in equation (A)

$$\begin{aligned} -\frac{5(6)}{10} &= 9 - \frac{10}{5}(6) \\ -\frac{30}{10} &= 9 - \frac{60}{5} \\ -3 &= 9 - 12 \\ -3 &= -3 \\ \text{S.S} &= \{6\} \end{aligned}$$

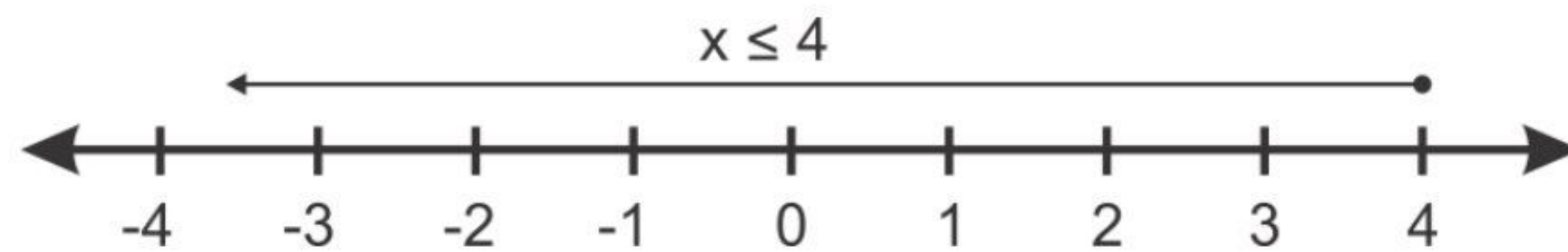


Question # 2: Solve each inequality and represent on a real line.

(i) $x - 6 \leq -2$

$$x \leq -2 + 6$$

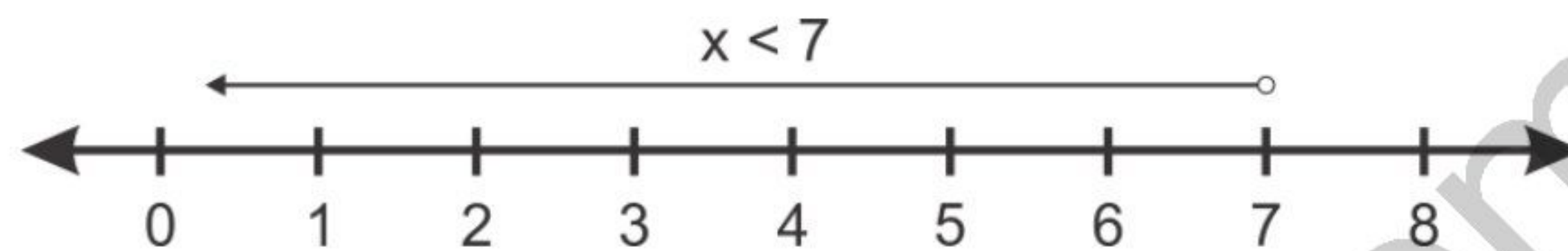
$$x \leq 4$$



(ii) $-9 > -16 + x$

$$-9 + 16 > x$$

$$7 > x$$



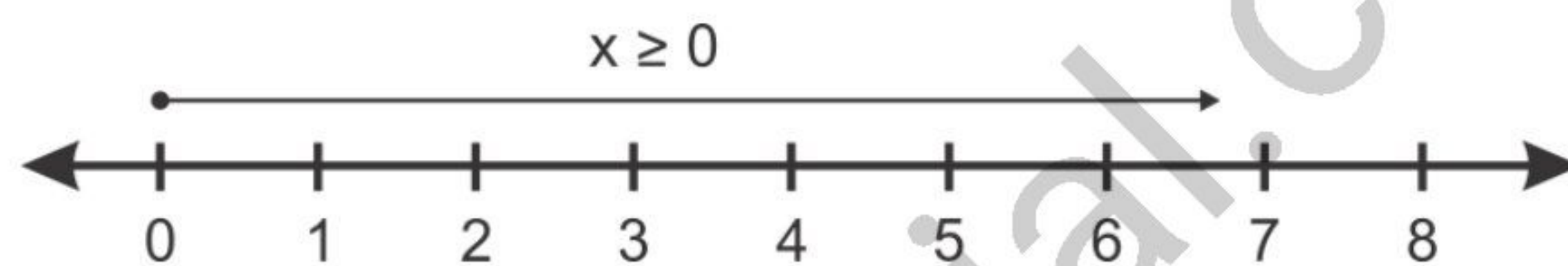
(iii) $3 + 2x \geq 3$

$$2x \geq 3 - 3$$

$$2x \geq 0$$

$$x \geq \frac{0}{2}$$

$$x \geq 0$$



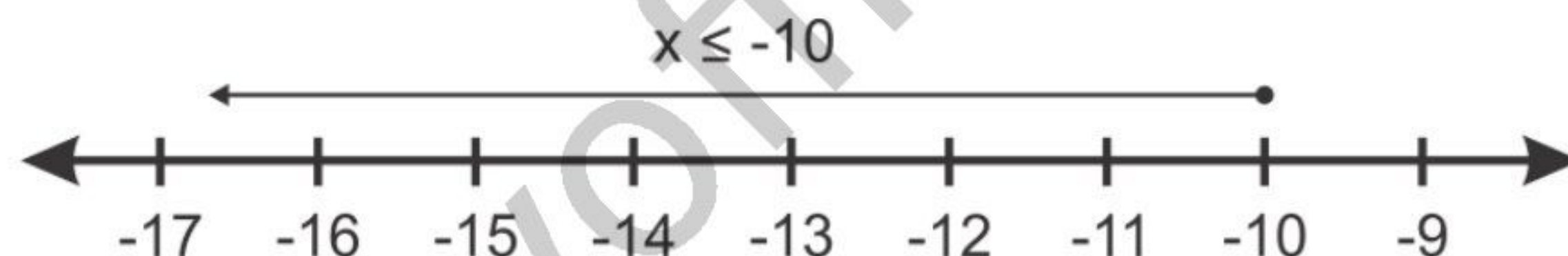
(iv) $6(x + 10) \leq 0$

$$6x + 60 \leq 0$$

$$6x \leq -60$$

$$x \leq -\frac{60}{6}$$

$$x \leq -10$$



(v) $\frac{5}{3}x - \frac{3}{4} < \frac{-1}{12}$

Multiply by '12' on both sides

$$12 \times \frac{5}{3}x - 12 \times \frac{3}{4} < 12 \times \frac{-1}{12}$$

$$20x - 9 < -1$$

$$20x < -1 + 9$$

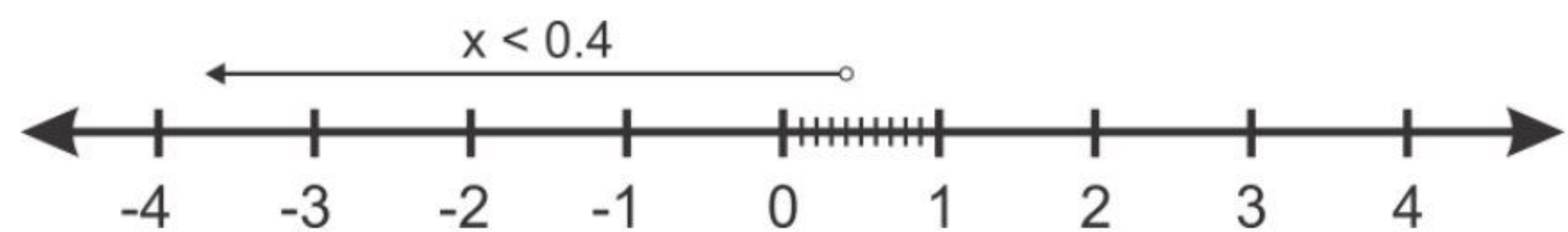
$$20x < 8$$

$$x < \frac{8}{20}$$

$$x < \frac{2}{5}$$

$$x < 0.4$$

2	3,4,12
2	3,2,6
3	3,1,3
	1,1,1



(vi) $\frac{1}{4}x - \frac{1}{2} \leq -1 + \frac{1}{2}x$

Multiply by '4' on both sides

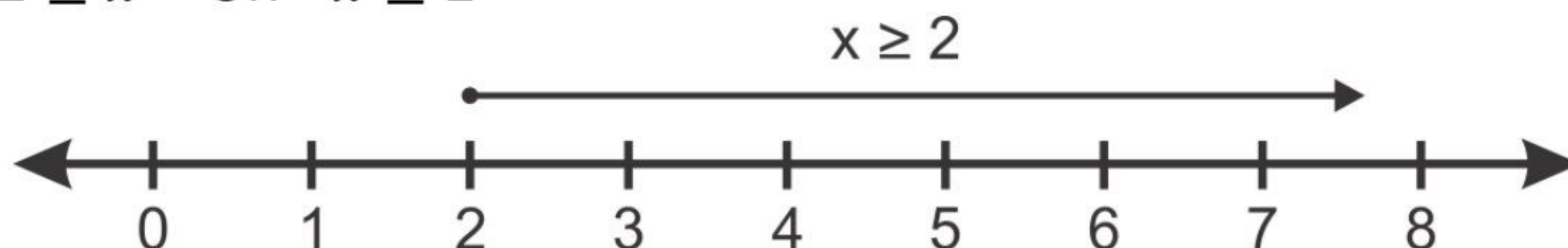
$$4 \times \frac{1}{4}x - 4 \times \frac{1}{2} \leq -4 \times 1 + 4 \times \frac{1}{2}x$$

$$x - 2 \leq -4 + 2x$$

$$-2 + 4 \leq 2x - x$$

$$2 \leq x \quad \text{OR} \quad x \geq 2$$

2	4,2,2
2	2,1,1
	1,1,1



Question # 3: Shade the solution region for the following linear inequalities in xy-plane.

(i) $2x + y \leq 6$

(a) **Associated Equation**

$2x + y = 6$ _____(A)

(b) **x – Intercept**

put $y = 0$ in equation (A)

$$2x + 0 = 6$$

$$2x = 6$$

$$x = \frac{6}{2}$$

$$x = 3$$

$$P_1 (3,0)$$

(c) **y – Intercept**

put $x = 0$ in equation (A)

$$2(0) + y = 6$$

$$y = 6$$

$$P_2 (0,6)$$

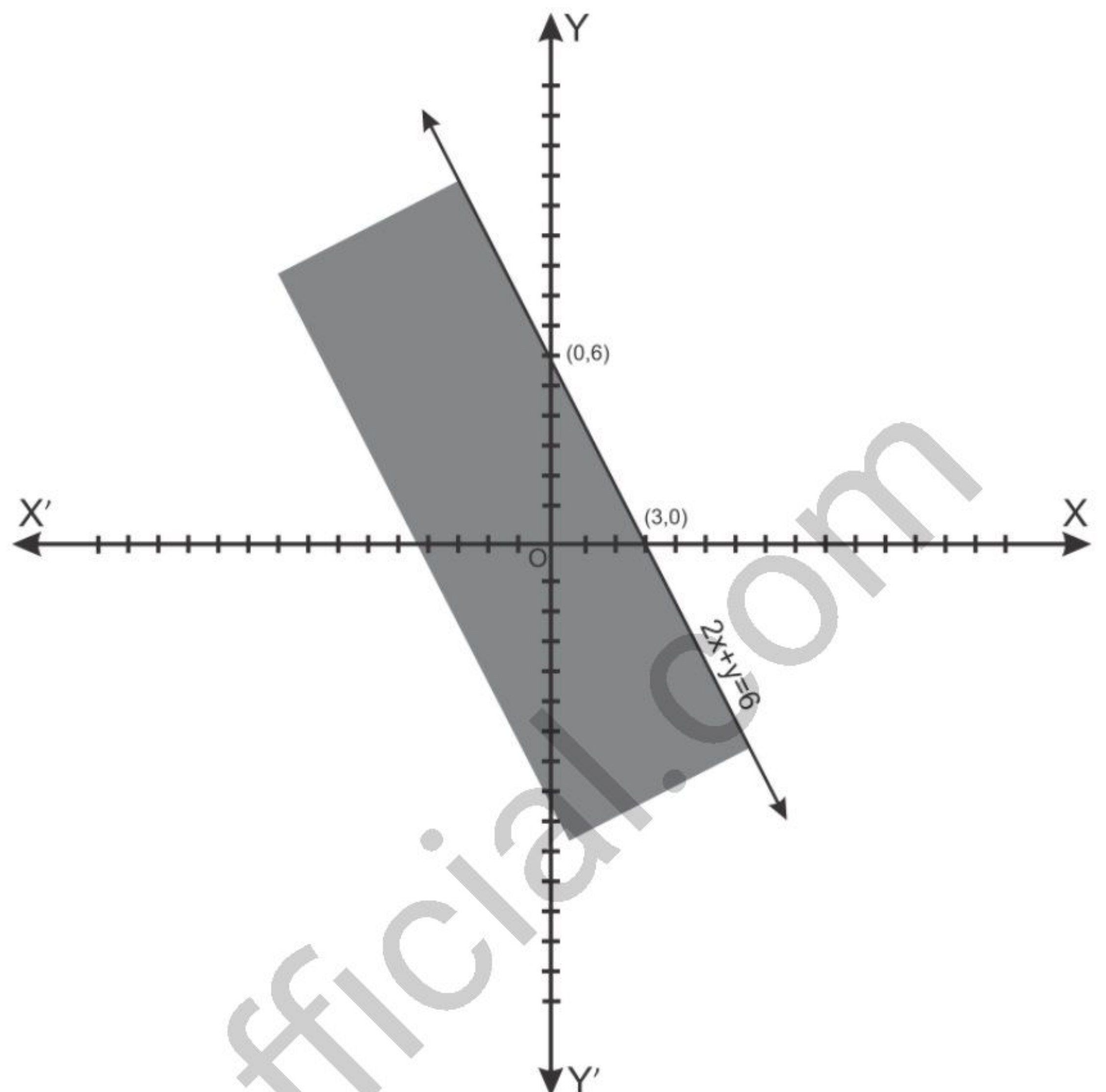
(d) **Test Point (0,0)**

put $x = 0, y = 0$ in given inequality

$$2(0) + 0 \leq 6$$

$$0 \leq 6 \text{ (True)}$$

Solution Region lies towards the Origin



(ii) $3x + 7y \geq 21$

(a) **Associated Equation**

$3x + 7y = 21$ _____(A)

(b) **x – Intercept**

put $y = 0$ in equation (A)

$$3x + 7(0) = 21$$

$$3x = 21$$

$$x = \frac{21}{3}$$

$$x = 7$$

$$P_1 (7,0)$$

(c) **y – Intercept**

put $x = 0$ in equation (A)

$$2(0) + 7y = 21$$

$$7y = 21$$

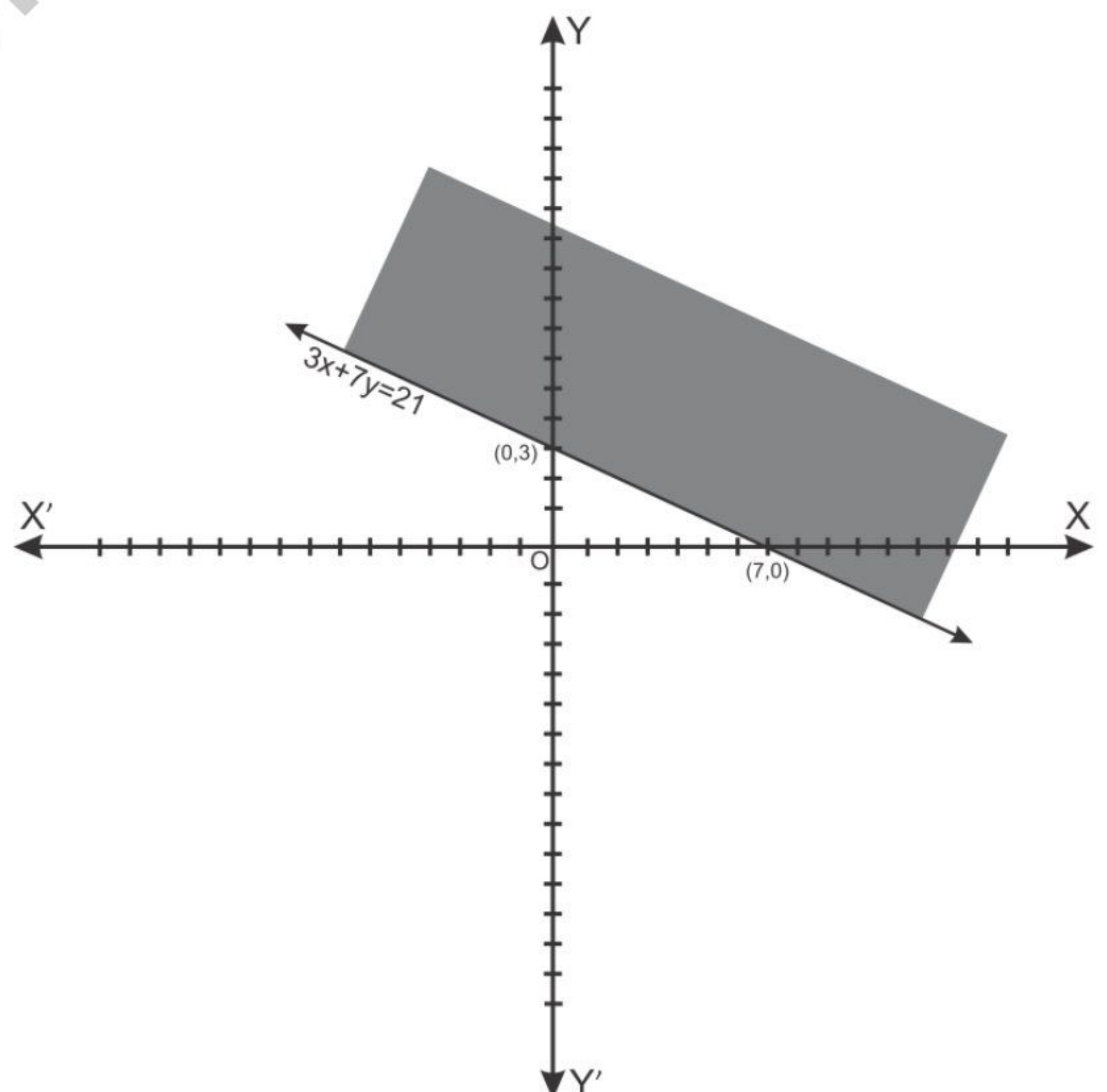
$$y = \frac{21}{7}$$

$$y = 3$$

$$P_2 (0,3)$$

(d) **Test Point (0,0)**

put $x = 0, y = 0$ in given inequality



$$3(0) + 7(0) \geq 21$$

$$0 \geq 21 \text{ (False)}$$

Solution Region lies away from Origin

(iii) $3x - 2y \geq 6$

(a) **Associated Equation**

$$3x - 2y = 6 \text{ (A)}$$

(b) **x – Intercept**

put $y = 0$ in equation (A)

$$3x - 2(0) = 6$$

$$3x = 6$$

$$x = \frac{6}{3}$$

$$x = 2$$

$$P_1 (2,0)$$

(c) **y – Intercept**

put $x = 0$ in equation (A)

$$3(0) - 2y = 6$$

$$-2y = 6$$

$$y = \frac{6}{-2}$$

$$y = -3$$

$$P_2 (0, -3)$$

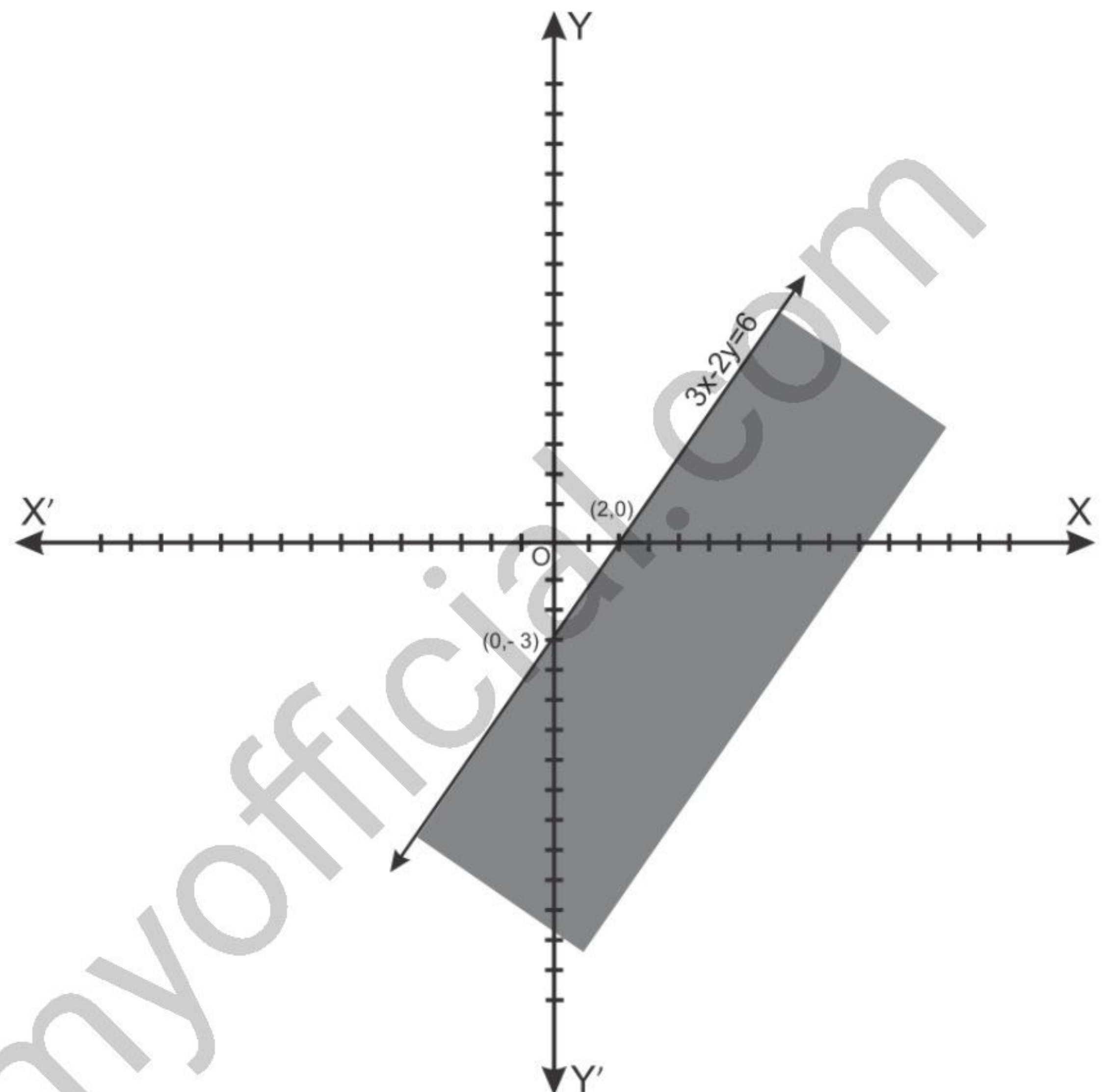
(d) **Test Point (0,0)**

put $x = 0, y = 0$ in given inequality

$$3(0) - 2(0) \geq 6$$

$$0 \geq 6 \text{ (False)}$$

Solution Region lies away from Origin



(iv) $5x - 4y \leq 20$

(a) **Associated Equation**

$$5x - 4y = 20 \text{ (A)}$$

(b) **x – Intercept**

put $y = 0$ in equation (A)

$$5x - 4(0) = 20$$

$$5x = 20$$

$$x = \frac{20}{5}$$

$$x = 4$$

$$P_1 (4,0)$$

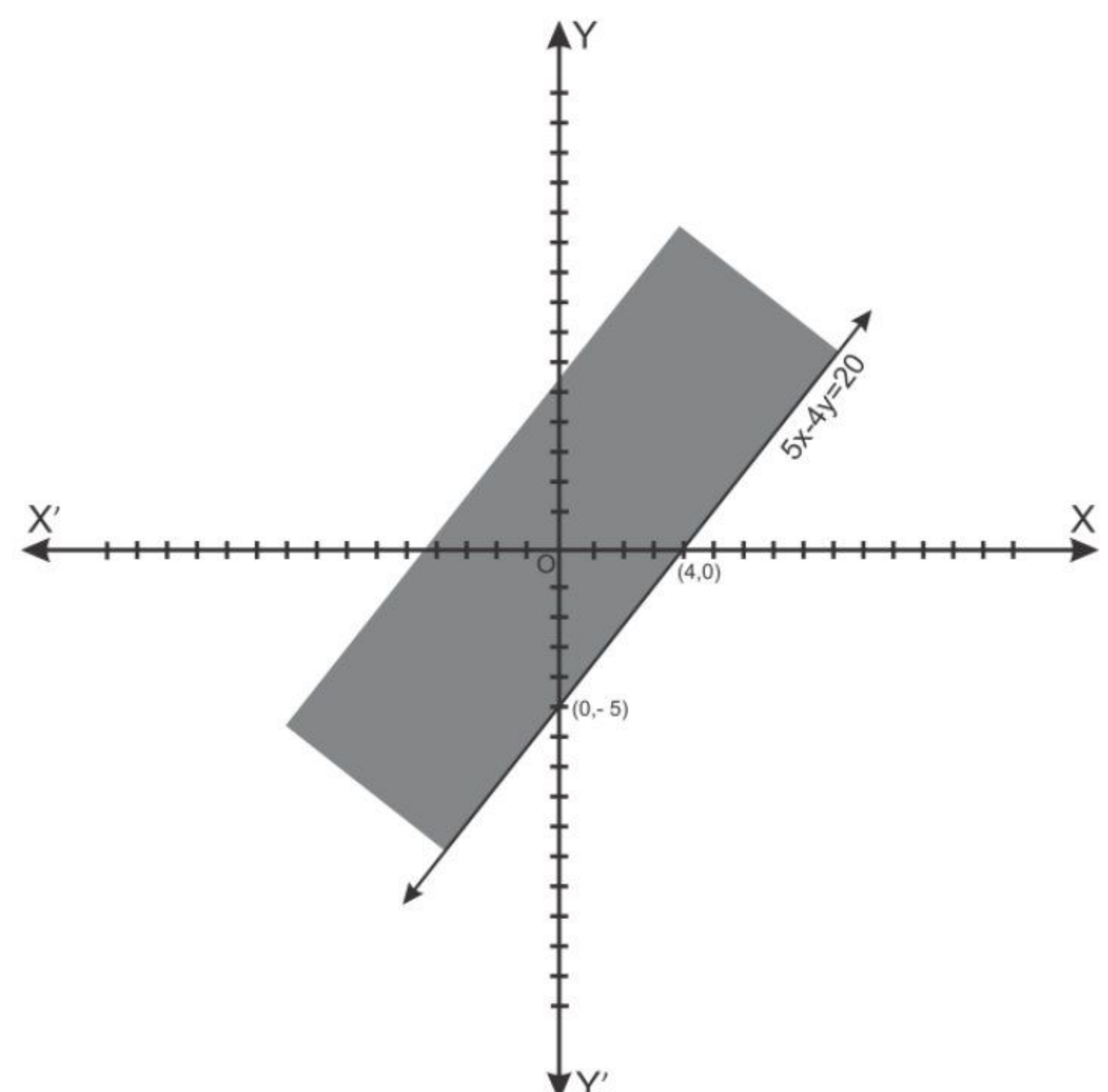
(c) **y – Intercept**

put $x = 0$ in equation (A)

$$5(0) - 4y = 20$$

$$-4y = 20$$

$$y = \frac{20}{-4}$$



$$y = -5$$

$$P_2 (0, -5)$$

(d) Test Point (0,0)

put $x = 0, y = 0$ in given inequality

$$5(0) - 4(0) \leq 20$$

$$0 \leq 20 \text{ (True)}$$

Solution Region lies towards the Origin

(v) $2x + 1 \geq 0$

(a) Associated Equation

$$2x + 1 = 0$$

$$2x = -1$$

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

$$x = -0.5$$

$$P (-0.5, 0)$$

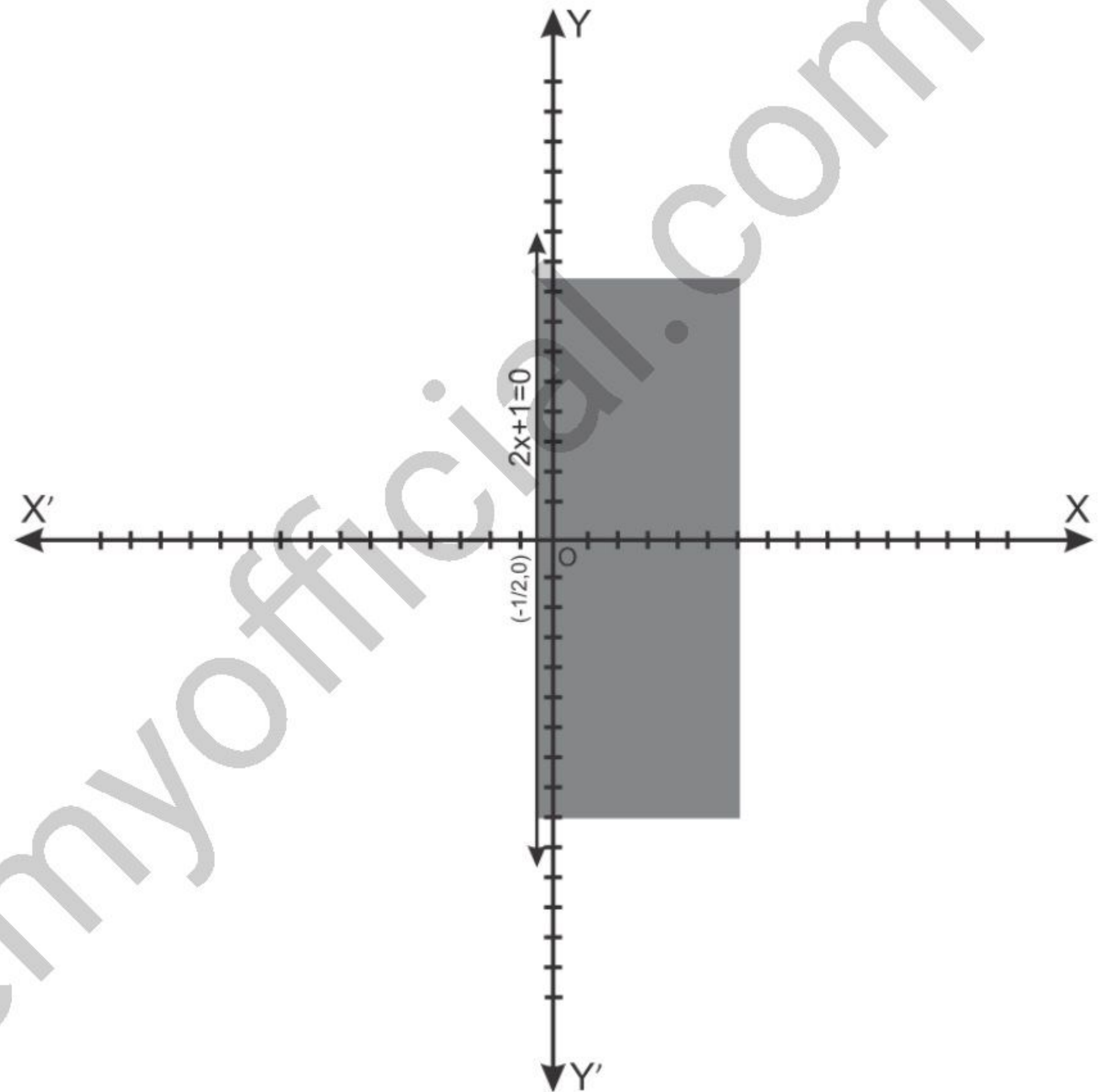
(b) Test Point

put $x = 0$ in given inequality

$$2(0) + 1 \geq 0$$

$$1 \geq 0 \text{ (True)}$$

Solution Region lies towards the Origin



(vi) $3y - 4 \leq 0$

(a) Associated Equation

$$3y - 4 = 0$$

$$3y = 4$$

$$y = \frac{4}{3}$$

$$x = 1.3$$

$$P (1.3, 0)$$

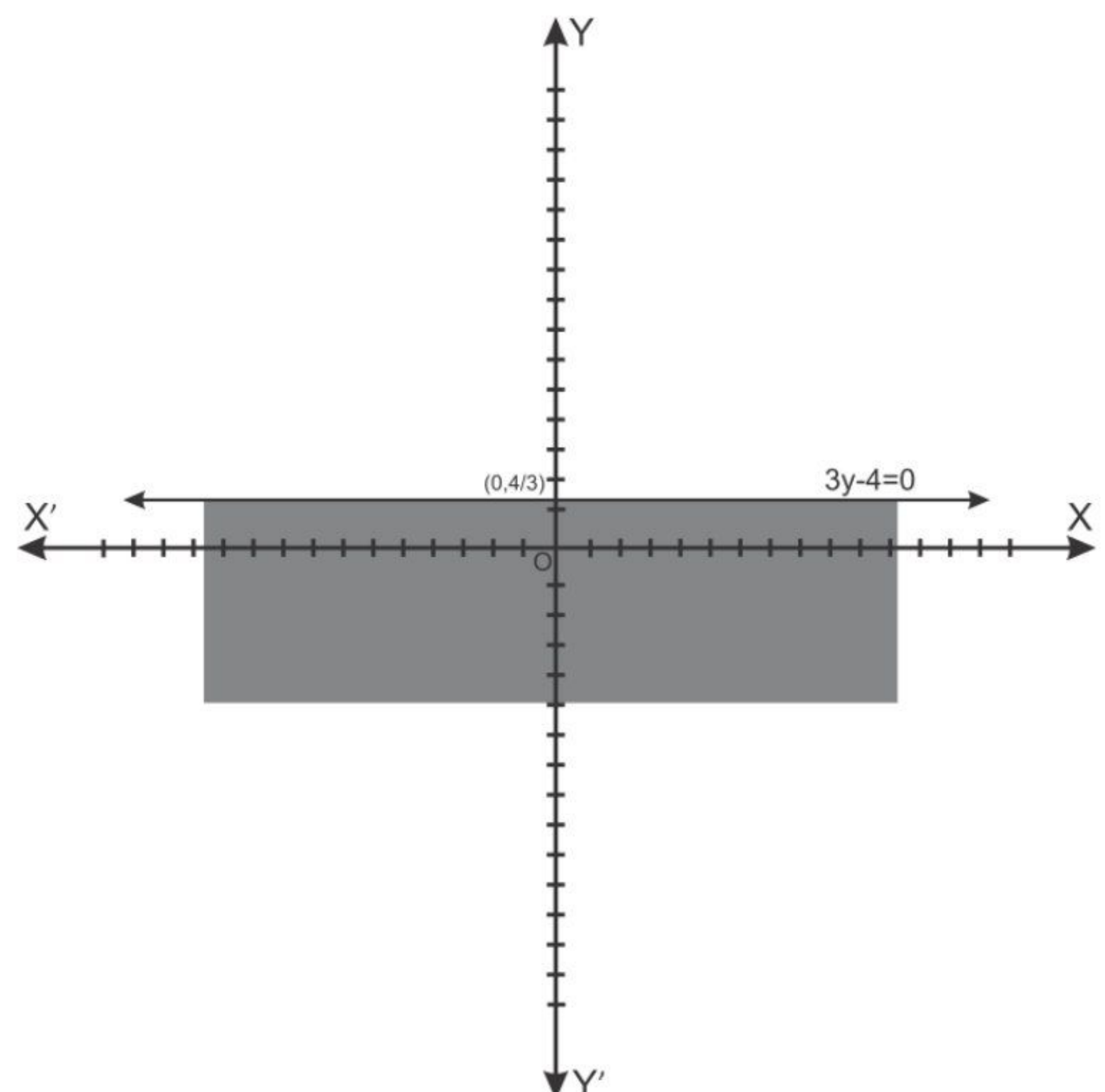
(b) Test Point

put $y = 0$ in given inequality

$$3(0) - 4 \leq 0$$

$$-4 \leq 0 \text{ (True)}$$

Solution Region lies towards the Origin



Question # 4: Indicate the solution region of the following linear inequalities by shading.

(i) $2x - 3y \leq 6$; $2x + 3y \leq 12$

(a) **Associated Equations**

$2x - 3y = 6$ _____(A)

$2x + 3y = 12$ _____(B)

(b) **x – Intercept**

put $y = 0$ in equations (A) and (B)

$2x - 3(0) = 6$

$2x = 6$

$x = \frac{6}{2}$

$x = 3$

$P_1 (3,0)$

$2x + 3(0) = 12$

$2x = 12$

$x = \frac{12}{2}$

$x = 6$

$P_3 (6,0)$

(c) **y – Intercept**

put $x = 0$ in equations (A) and (B)

$2(0) - 3y = 6$

$-3y = 6$

$y = \frac{6}{-3}$

$y = -2$

$P_2 (0, -2)$

$2(0) + 3y = 12$

$3y = 12$

$y = \frac{12}{3}$

$P_4 (0,4)$

(d) **Test Point (0,0)**

put $x = 0, y = 0$ in given inequalities

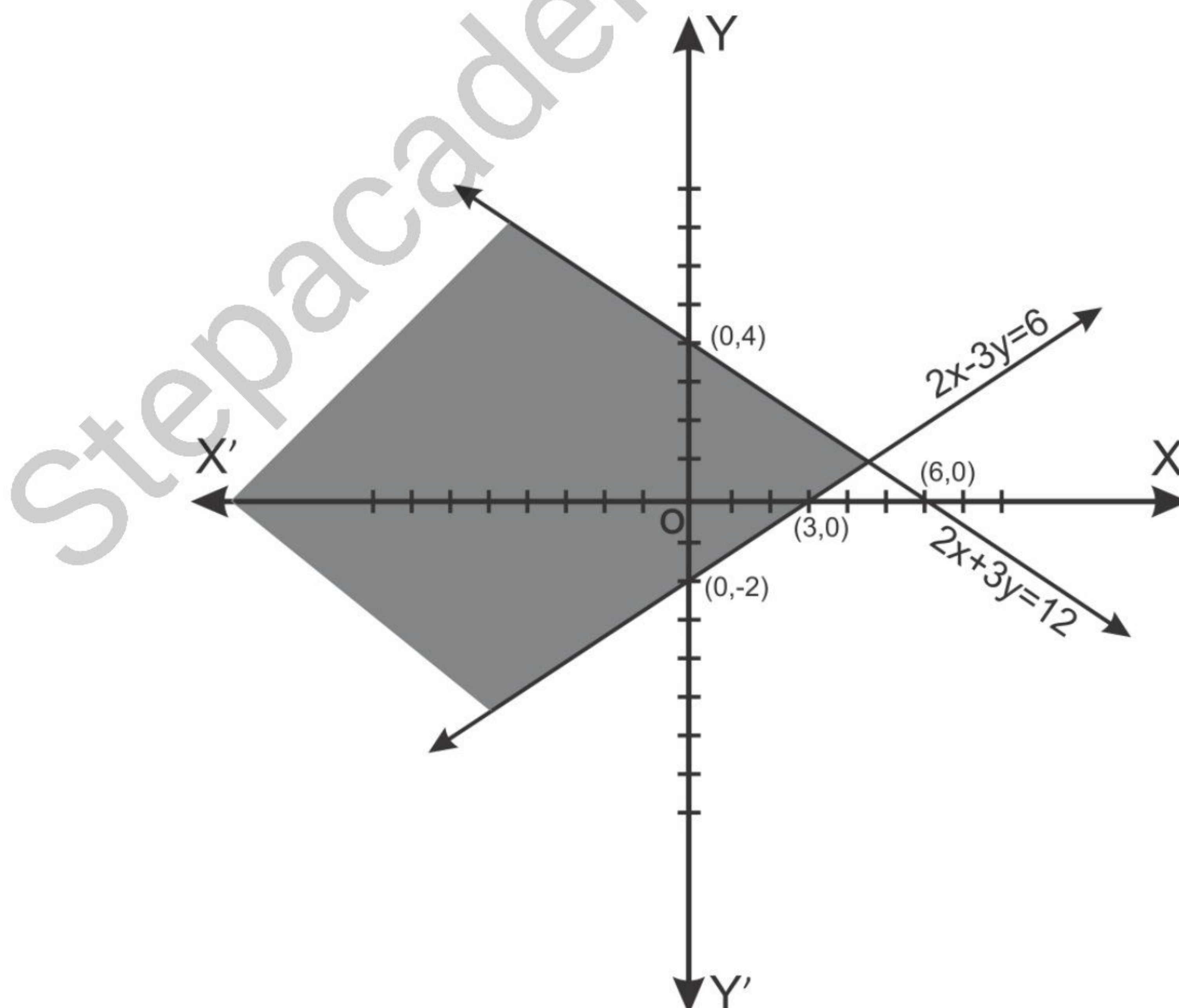
$2(0) - 3(0) \leq 6$

$0 \leq 6$ (True)

$2(0) + 3(0) \leq 12$

$0 \leq 12$ (True)

Solution Regions lie towards the origin



(ii) $x + y \geq 5$; $-y + x \leq 1$

(a) **Associated Equations**

$x + y = 5$ _____(A)

$-y + x = 1$ _____(B)

(b) **x – Intercept**

put $y = 0$ in equations (A) and (B)

$x + 0 = 5$

$x = 5$

$P_1 (5,0)$

$-0 + x = 1$

$x = 1$

$P_3 (1,0)$

(c) **y – Intercept**

put $x = 0$ in equations (A) and (B)

$0 + y = 5$

$y = 5$

$P_2 (0,5)$

$-y + 0 = 1$

$-y = 1$

$y = -1$

$P_4 (0, -1)$

(d) **Test Point (0,0)**

put $x = 0, y = 0$ in given inequalities

$0 + 0 \geq 5$

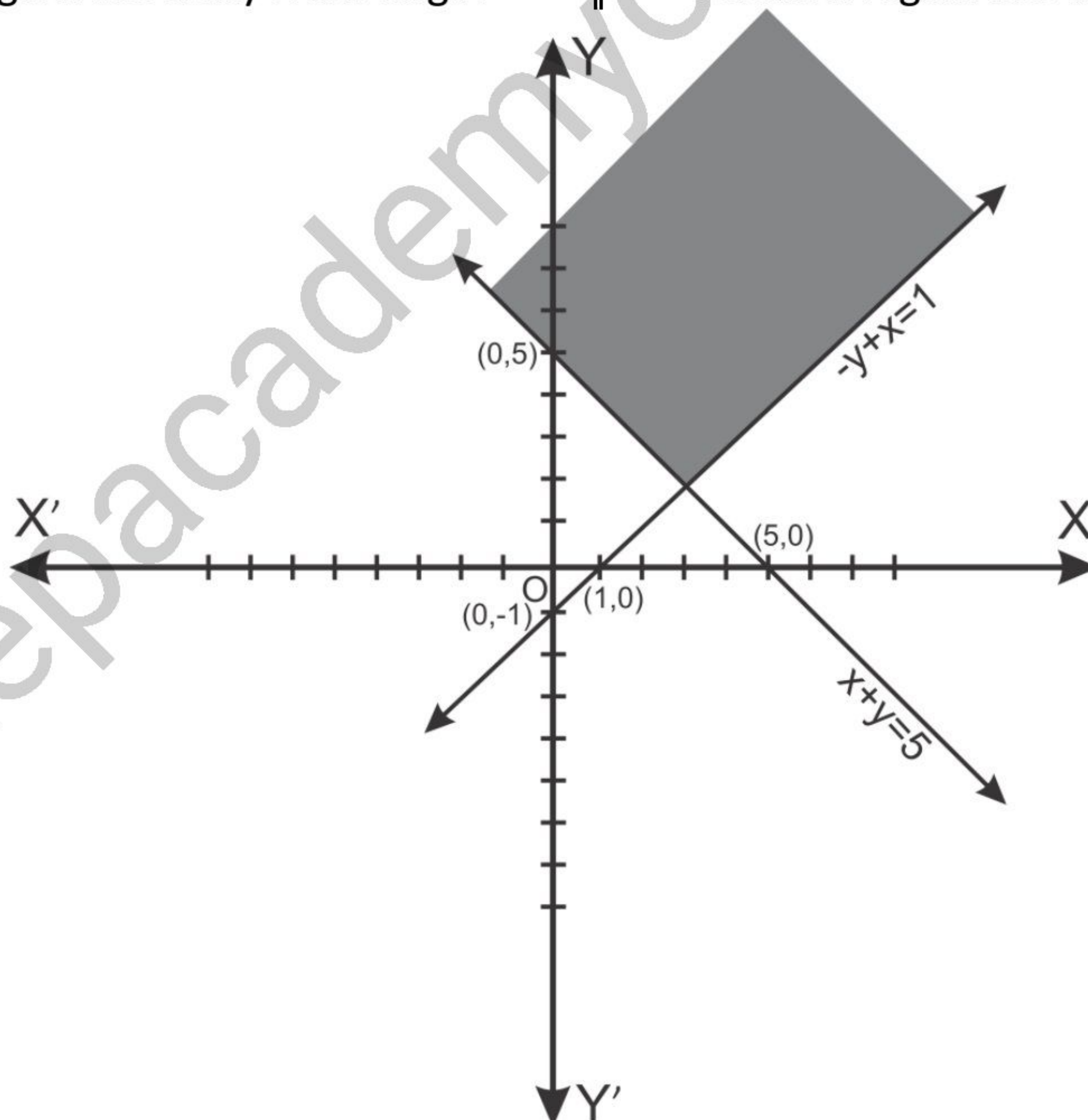
$0 \geq 5$ (False)

Solution region lies away from origin

$-0 + 0 \leq 1$

$0 \leq 1$ (True)

Solution region lies towards origin



(iii) $3x + 7y \geq 21$; $x - y \leq 2$

(a) **Associated Equations**

$3x + 7y = 21$ _____(A)

$x - y = 2$ _____(B)

(b) **x – Intercept**

put $y = 0$ in equations (A) and (B)

$3x + 7(0) = 21$

$3x = 21$

$x = \frac{21}{3}$

$x = 7$

$P_1(7,0)$

$x - 0 = 2$

$x = 2$

$P_3(2,0)$

(c) **y – Intercept**

put $x = 0$ in equations (A) and (B)

$3(0) + 7y = 21$

$7y = 21$

$y = \frac{21}{7}$

$y = 3$

$P_2(0,3)$

$0 - y = 2$

$-y = 2$

$y = -2$

$P_4(0,-2)$

(d) **Test Point (0,0)**

put $x = 0, y = 0$ in given inequalities

$3(0) + 7(0) \geq 21$

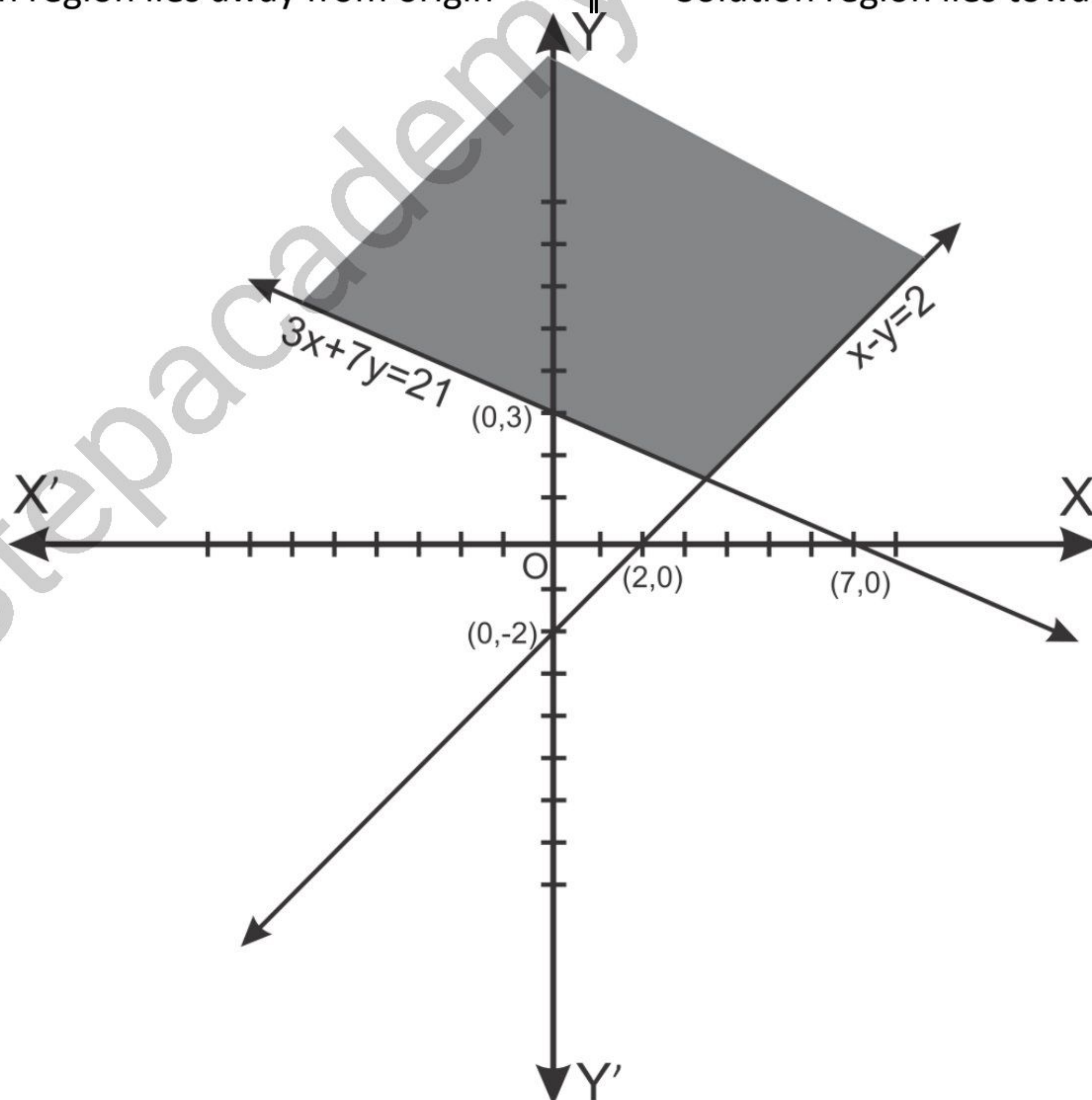
$0 \geq 21$ (False)

Solution region lies away from origin

$0 - 0 \leq 2$

$0 \leq 2$ (True)

Solution region lies towards origin



(iv) $4x - 3y \leq 12$; $x \geq -\frac{3}{2}$

(a) **Associated Equations**

$4x - 3y = 12$ _____ (A)

(b) **x – Intercept**

put $y = 0$ in equations (A)

$4x - 3(0) = 12$

$4x = 12$

$x = \frac{12}{4}$

$x = 3$

$P_1 (3,0)$

(c) **y – Intercept**

put $x = 0$ in equations (A)

$4(0) - 3y = 12$

$-3y = 12$

$y = \frac{12}{-3}$

$y = -4$

$P_2 (0, -4)$

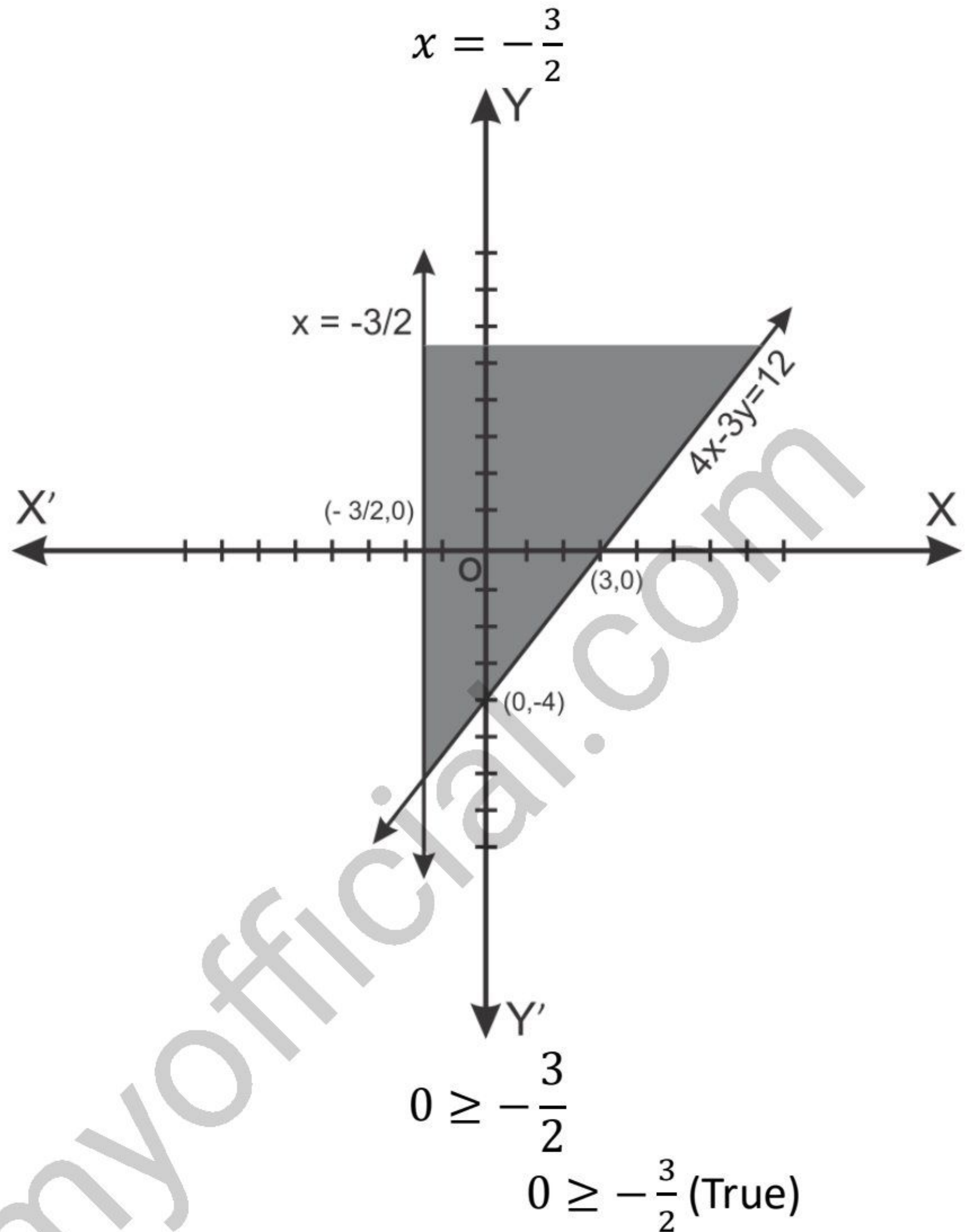
(d) **Test Point (0,0)**

put $x = 0, y = 0$ in given inequalities

$4(0) - 3(0) \leq 12$

$0 \leq 12$ (True)

Solution Regions lie towards the origin



(v) $3x + 7y \geq 21$; $y \leq 4$

(a) **Associated Equations**

$3x + 7y = 21$ _____ (A)

(b) **x – Intercept**

put $y = 0$ in equations (A)

$3x + 7(0) = 21$

$3x = 21$

$x = \frac{21}{3}$

$x = 7$

$P_1 (7,0)$

(d) **Test Point (0,0)**

put $x = 0, y = 0$ in given inequalities

$3(0) + 7(0) \geq 21$

$0 \geq 21$ (False)

Solution Region lies away from origin

(c) **y – Intercept**

put $x = 0$ in equations (A)

$3(0) + 7y = 21$

$7y = 21$

$y = \frac{21}{7}$

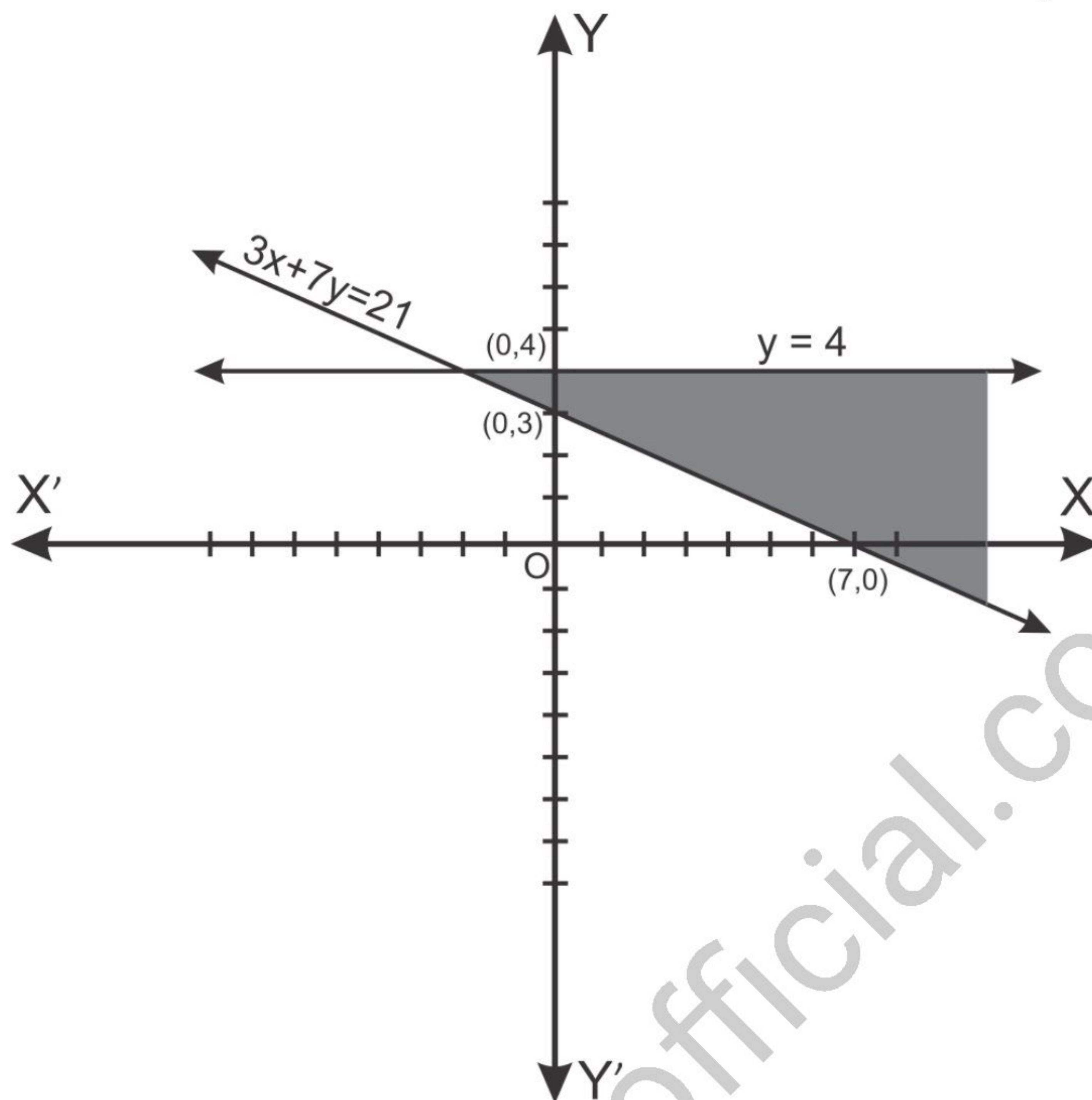
$y = 3$

$P_2 (0,3)$

$0 \leq 4$

$0 \leq 4$ (True)

Solution region lies towards origin



(vi) $5x + 7y \leq 35$; $x - 2y \leq 2$

(a) Associated Equations

$5x + 7y = 35$ _____(A)

$x - 2y = 2$ _____(B)

(b) x – Intercept

put $y = 0$ in equations (A) and (B)

$5x + 7(0) = 35$

$5x = 35$

$x = \frac{35}{5}$

$x = 7$

$P_1 (7,0)$

$x - 2(0) = 2$

$x = 2$

$P_3 (2,0)$

(c) y – Intercept

put $x = 0$ in equations (A) and (B)

$5(0) + 7y = 35$

$7y = 35$

$y = \frac{35}{7}$

$y = 5$

$P_2 (0,5)$

$0 - 2y = 2$

$-2y = 2$

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

$P_4 (0, -1)$

(d) Test Point (0,0)

put $x = 0, y = 0$ in given inequalities

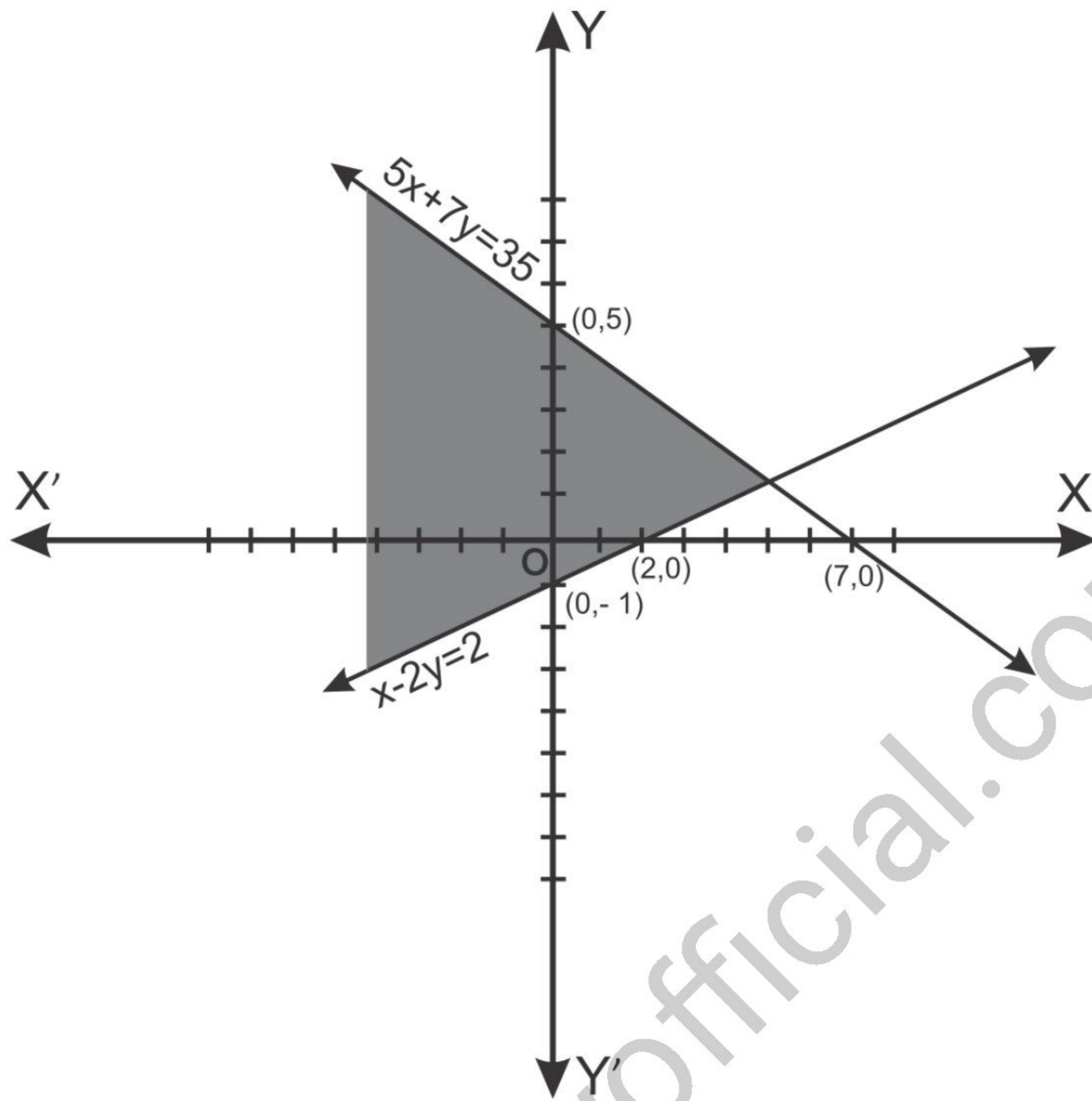
$5(0) + 7(0) \leq 35$

$0 \leq 35$ (True)

$0 - 2(0) \leq 2$

$0 \leq 2$ (True)

Solution regions lie towards origin



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