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13. Find equation of the line passing through the point (2, 2) and cutting off intercepts on the axes whose sum is 9.

Solution:

We know that equation of the line making intercepts a and b on x-and y-axis, respectively, is $x/a + y/b = 1$ (1)

Given: sum of intercepts = 9

$$a + b = 9$$

$$b = 9 - a$$

Now, substitute value of b in the above equation, we get

$$x/a + y/(9 - a) = 1$$

Given: the line passes through the point (2, 2),

$$\text{So, } 2/a + 2/(9 - a) = 1$$

$$[2(9 - a) + 2a] / a(9 - a) = 1$$

$$[18 - 2a + 2a] / a(9 - a) = 1$$

$$18/a(9 - a) = 1$$

$$18 = a(9 - a)$$

$$18 = 9a - a^2$$

$$a^2 - 9a + 18 = 0$$

Upon factorizing, we get

$$a^2 - 3a - 6a + 18 = 0$$

$$a(a - 3) - 6(a - 3) = 0$$

$$(a - 3)(a - 6) = 0$$

$$a = 3 \text{ or } a = 6$$

Let us substitute in (1),

Case 1 (a = 3):

$$\text{Then } b = 9 - 3 = 6$$

$$x/3 + y/6 = 1$$

$$2x + y = 6$$

$$2x + y - 6 = 0$$

Case 2 (a = 6):

$$\text{Then } b = 9 - 6 = 3$$

$$x/6 + y/3 = 1$$

$$x + 2y = 6$$

$$x + 2y - 6 = 0$$

∴ The equation of the line is $2x + y - 6 = 0$ or $x + 2y - 6 = 0$.

14. Find equation of the line through the point (0, 2) making an angle $2\pi/3$ with the positive x-axis. Also, find the equation of line parallel to it and crossing the y-axis at a distance of 2 units below the origin.

Solution:

Given:

Point (0, 2) and $\theta = 2\pi/3$

We know that $m = \tan \theta$

$$m = \tan (2\pi/3) = -\sqrt{3}$$

We know that the point (x, y) lies on the line with slope m through the fixed point (x_0, y_0) , if and only if, its coordinates satisfy the equation $y - y_0 = m (x - x_0)$

$$y - 2 = -\sqrt{3} (x - 0)$$

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

$$\sqrt{3} x + y - 2 = 0$$

Given, equation of line parallel to above obtained equation crosses the y-axis at a distance of 2 units below the origin.

So, the point = (0, -2) and $m = -\sqrt{3}$

From point slope form equation,

$$y - (-2) = -\sqrt{3} (x - 0)$$

$$y + 2 = -\sqrt{3} x$$

$$\sqrt{3}x + y + 2 = 0$$

\therefore The equation of line is $\sqrt{3}x + y - 2 = 0$ and the line parallel to it is $\sqrt{3}x + y + 2 = 0$