

## Step-1

Consider equation of a line is  $x + 4y = 7$

The objective is to determine the equation for the parallel line through the point  $x = 0, y = 0$ .

Also, determine the equation of the line that intersects the line  $x + 4y = 7$  at the point  $x = 3, y = 1$ .

## Step-2

Assume the equation of the line is  $x + 4y = 7$ .

It can be rewritten as,

$$4y = -x + 7$$
$$y = -\frac{1}{4}x + \frac{7}{4}$$

For an equation  $y = mx + c$ ,  $m$  represents the slope of the line.

Compare  $y = -\frac{1}{4}x + \frac{7}{4}$  with equation (1).

Thus, the slope is  $m = -\frac{1}{4}$

Recall that any parallel lines have the same slope.

Therefore, the line  $y = ax + b$  that is, parallel to  $x + 4y = 7$  has slope  $a = -\frac{1}{4}$ .

The equation of line is rewritten as,

$$y = -\frac{1}{4}x + b$$

## Step-3

Now, calculate the unknown value  $b$ .

The line  $y = -\frac{1}{4}x + b$  passes through  $(0, 0)$ .

Substitute  $x = 0, y = 0$  to get,

$$y = -\frac{1}{4}x + b$$

$$0 = 0 + b$$

$$b = 0$$

Thus,  $b = 0$

Hence, a line that passes through  $(0,0)$  and is parallel to  $x + 4y = 7$  is given by,

$$y = -\frac{1}{4}x$$

## Step-4

Calculate the equation of line that intersects line  $x + 4y = 7$  at the point  $(3,1)$ .

Assume the line is perpendicular to line  $x + 4y = 7$  (There are other ways of intersection of line but here it is assumed that lines intersect with each other perpendicularly.)

Suppose the equation of line is  $y = m_1x + b$

Recall that for two perpendicular lines the slope  $m, m_1$  of the two lines satisfies the relation  $m \cdot m_1 = -1$ .

The slope of the line  $x + 4y = 7$  is given as  $m = -\frac{1}{4}$ .

Calculate the value of unknown slope  $m_1$

$$m \cdot m_1 = -1$$

$$-\frac{1}{4} \cdot m_1 = -1$$

$$m_1 = 4$$

The equation of line is given as,  $y = 4x + b$ .

Put  $x = 3, y = 1$  in the above equation to get,

$$1 = 4(3) + b$$

$$1 - 12 = b$$

$$b = -11$$

Thus,  $b = -11$

Substitute the value of  $m_1 = 4, b = -11$  to get,  $y = 4x - 11$

Hence, the equation of the line is  $y = 4x - 11$ .