3.6 Parallel and Perpendicular Lines

**Learning Objectives:**
1. Determine whether two lines are parallel or perpendicular.
2. Find the equation of a line parallel or perpendicular to a given line.

1. **Determine whether two lines are parallel or perpendicular**
   
   **Definition:**
   1. **Parallel Lines:** Two lines are parallel if \( m_1 = m_2 \) but \( b_1 \neq b_2 \).
   
   2. **Perpendicular Lines:** Two lines are perpendicular if \( m_1 m_2 = -1 \) or \( m_2 = \frac{1}{m_1} \) or \( m_1 = \frac{1}{m_2} \)

**Example 1.** Fill in the chart with the missing slopes.

<table>
<thead>
<tr>
<th>Slope of the Given Line</th>
<th>Slope of the Line Parallel to the Given Line</th>
<th>Slope of the Line Perpendicular to the Given Line</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) 12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) ( \frac{6}{5} )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c) Undefined</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d) ( -\frac{1}{3} )</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Example 2.** Determine if the lines are parallel, perpendicular, or neither.

1. \( L_1 \) : \( y = x + 2 \)
   
   \( L_2 \) : \( y = -x + 5 \)

2. \( L_4 \) : \( 2x - 3y = 3 \)
   
   \( L_2 \) : \( -4x + 6y = -24 \)

2. **Find the equation of a line parallel or perpendicular to a given line**

   **Steps:**
   1. Find the slope of the given line.
   2. Find the slope of the parallel or perpendicular line.
   3. Use the point-slope form of a line with the given point and the slope found in step 2 to find the equation of the parallel or perpendicular line.
   4. Write the equation in slope-intercept form by solving for \( y \).
Example 3. Find the equation of the line that has the given properties. Write the equation in slope-intercept form, if possible.

1. Contains $(1, -4)$; parallel to the line $3x + 2y = 9$

2. Contains $(-8, -3)$; perpendicular to the line $6x - 2y = -1$