Motion in multiple dimensions is dealt with as a simple extension of motion in one dimension. The principle that allows us to do this is that motion in one direction does not affect the motion in the perpendicular directions. This means that each direction gets its own set of equations of motion.

Here is an experiment to demonstrate this. The ball starts with a certain constant horizontal velocity as seen by the equally spaced marks made over equally elapsed time.

It is then accelerated only in the vertical direction. The resulting motion looks like this.

The horizontal motion is not changed by the vertical acceleration. Only the motion in the vertical direction is changed; it now has a velocity whereas before the tap it had not.
Equations of Motion in Two Dimensions

This result means that any two-dimensional problem can be approached as two one-dimensional problems. Each one dimensional problem has its own set of equations of motion. Therefore, we will have two sets of equations of motion when we have two dimensions.

\[
\begin{align*}
\Delta v_x &= a_x \Delta t \\
\Delta v_y &= a_y \Delta t \\
\Delta x &= v_{ix} \Delta t + \frac{1}{2} a_x \Delta t^2 \\
\Delta y &= v_{iy} \Delta t + \frac{1}{2} a_y \Delta t^2 \\
\Delta(v_x^2) &= 2a_x \Delta x \\
\Delta(v_y^2) &= 2a_y \Delta y
\end{align*}
\]

All of the information can be organized in the following way.

<table>
<thead>
<tr>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>a_x</td>
<td>a_y</td>
</tr>
<tr>
<td>t_i</td>
<td>t_f</td>
</tr>
<tr>
<td>x_i</td>
<td>x_f</td>
</tr>
<tr>
<td>v_{i,x}</td>
<td>v_{f,x}</td>
</tr>
<tr>
<td>v_{i,y}</td>
<td>v_{f,y}</td>
</tr>
</tbody>
</table>