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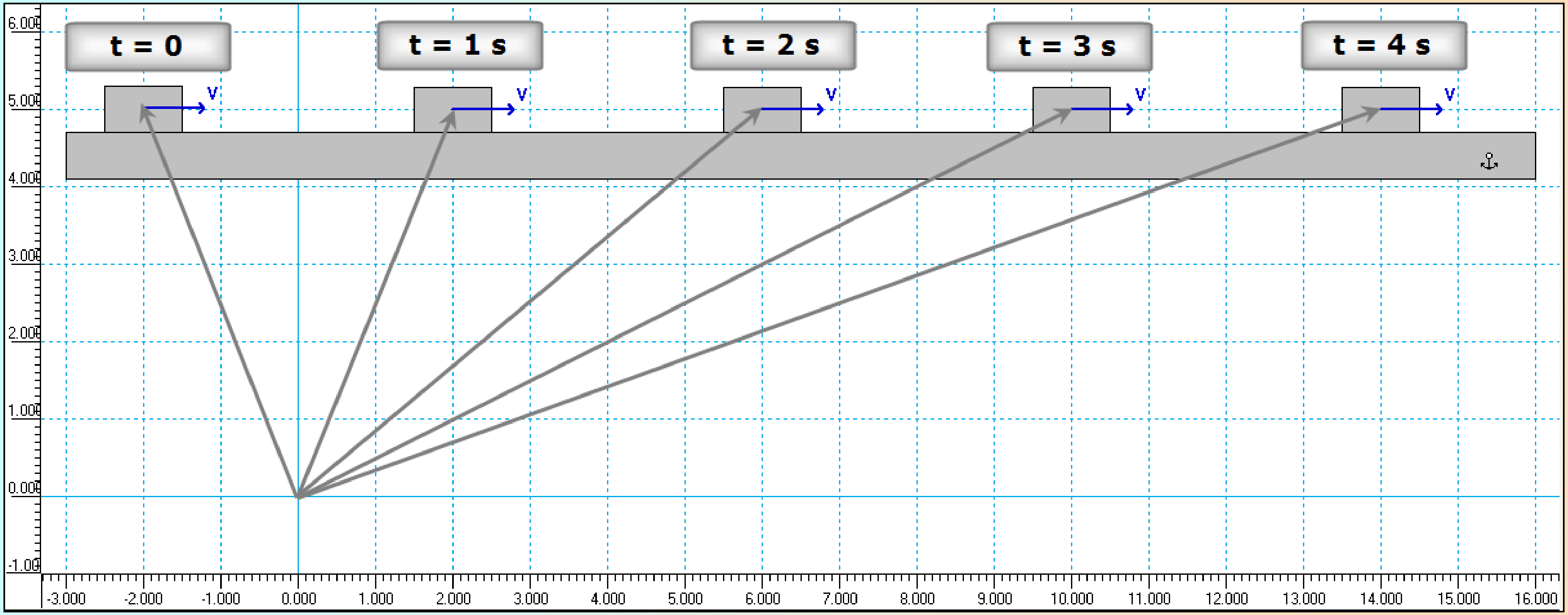
Motion with Constant Velocity

time (s)	X pos (m)	Y pos (m)
0	-2	5
1	2	5
2	6	5
3	10	5
4	14	5
t	-2 + 4*t	5

In this table you will find the **position** of the body at different moments (t=0, 1s, 2s, 3s and 4s) and the equation of the position.

This equation is useful, because you can know **the position of the moving body at any moment**: the only thing you need to do is to specify the value of time and then you get the position of the body.



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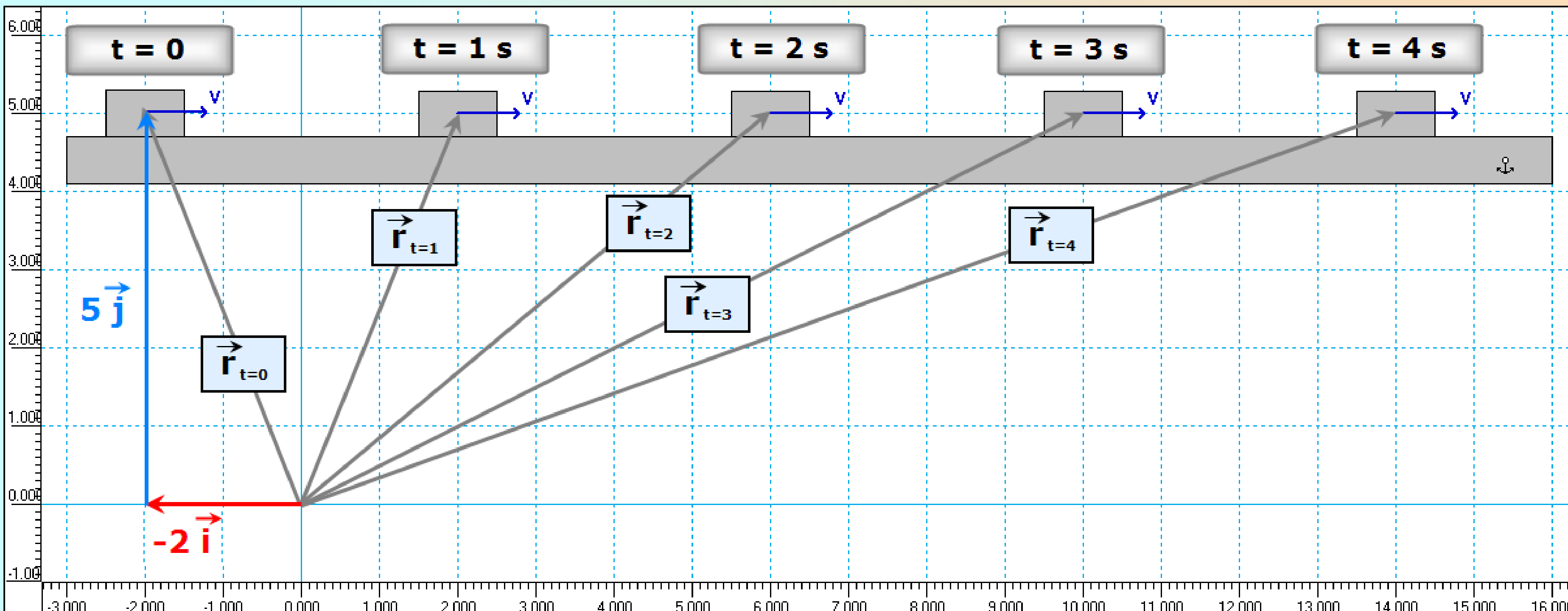
time (s)	position vector
0	$\vec{r}_{t=0} = -2\,\vec{i} + 5\,\vec{j}$ (m)
1	$\vec{r}_{t=1} = 2\,\vec{i} + 5\,\vec{j}$ (m)
2	$\vec{r}_{t=2} = 6\,\vec{i} + 5\,\vec{j}$ (m)
3	$\vec{r}_{t=3} = 10\,\vec{i} + 5\,\vec{j}$ (m)
4	$\vec{r}_{t=4} = 14\,\vec{i} + 5\,\vec{j}$ (m)
t	$\vec{r} = (-2 + 4*t)\,\vec{i} + 5\,\vec{j}$ (m)

In this table you will find the **position vectors** at different moments (t=0, 1s, 2s, 3s and 4s) and the equation of the position vector.

This equation is useful, because you can know **the position vector of the moving body at any moment**: the position vector encloses information about both coordinates, X and Y.



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When the body moves horizontaly (in one dimension), the general expression of the position vector has the following factors:

•X coordinate; changes with time, according to this expression: the final position is the sum of the initial position and the displacement.

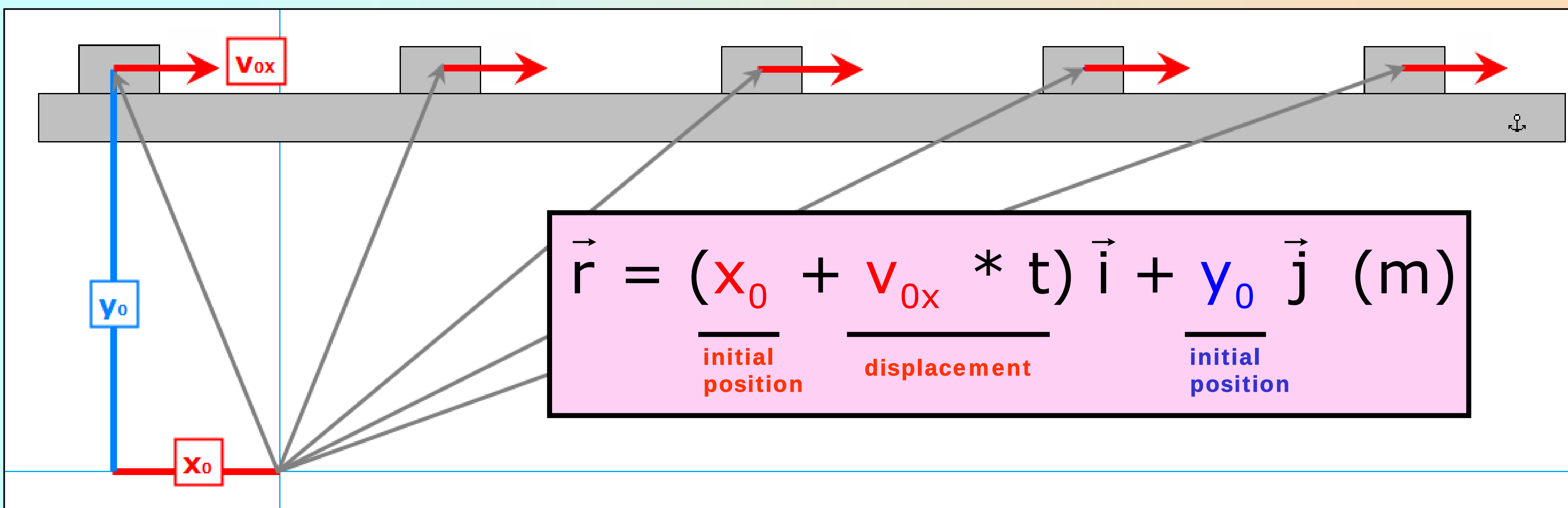
$$x = (x_0 + \Delta x)$$

The displacement is the rate of the displacement (that is, the displacement in each second) multiplied by the number of seconds of the interval

$$\Delta x = v_{0x} * t$$

•Y coordinate; it remains constant, unchanged.

$$y = y_0$$



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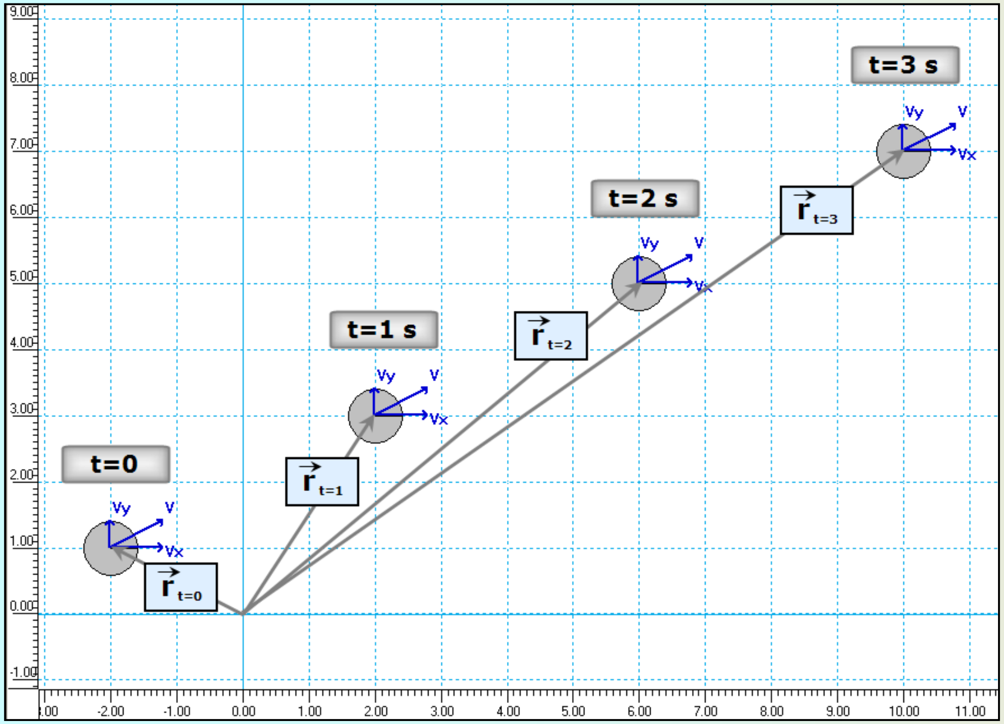

In this example, the motion is in two dimensions: both coordinates (X and Y) change with time.

In those tables we can see the positions at different moments, the equations of the coordinates and the position vectors (at different times and its equation).

In this case, the rates of displacements are:

$$v_x = v_{0x} = \frac{\Delta x}{\Delta t} = +4 \frac{m}{s}$$

$$v_y = v_{0y} = \frac{\Delta y}{\Delta t} = +2 \frac{m}{s}$$

time (s)	X pos (m)	Y pos (m)
0	-2	1
1	2	3
2	6	5
3	10	7
t	-2 + 4*t	1 + 2*t

time (s)	position vector
0	$\vec{r}_{t=0} = -2\,\vec{i} + \vec{j}$ (m)
1	$\vec{r}_{t=1} = 2\,\vec{i} + 3\,\vec{j}$ (m)
2	$\vec{r}_{t=2} = 6\,\vec{i} + 5\,\vec{j}$ (m)
3	$\vec{r}_{t=3} = 10\,\vec{i} + 7\,\vec{j}$ (m)
t	$\vec{r} = (-2+4*t)\,\vec{i} + (1+2*t)\,\vec{j}$ (m)

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When the body moves in two dimensions, the general expression of the position vector has the following factors:

•X coordinate; changes with time, according to this expression: the final position is the sum of the initial position and the displacement.

$$x = (x_0 + \Delta x)$$

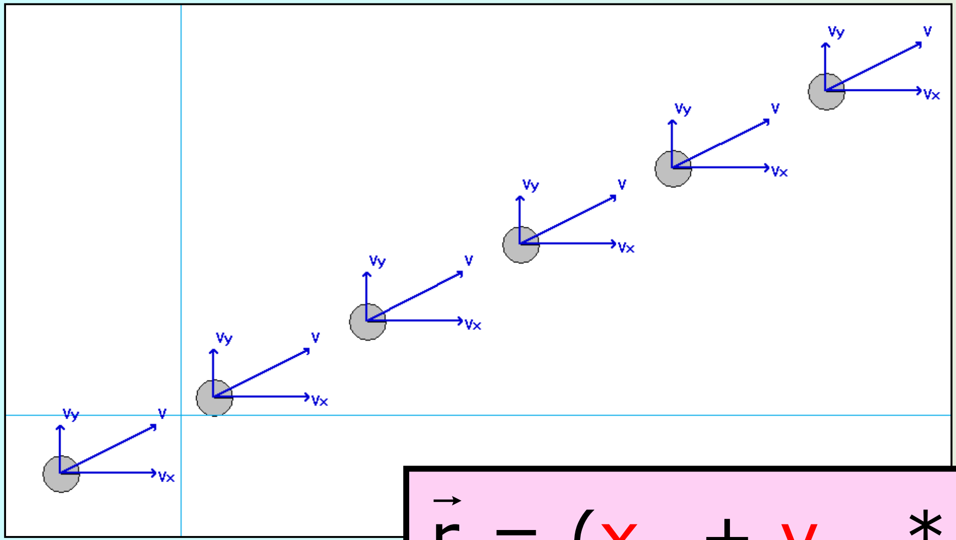
The displacement is the rate of the displacement (that is, the displacement in each second) multiplied by the number of seconds of the interval

$$\Delta x = v_{0x} * t$$

•Y coordinate also changes:

$$y = (y_0 + \Delta y)$$

$$\Delta y = v_{0y} * t$$



$$\vec{r} = (\underbrace{x_0}_{\text{initial position}} + \underbrace{v_{0x} * t}_{\text{displacement (change in position)}})\,\vec{i} + (\underbrace{y_0}_{\text{initial position}} + \underbrace{v_{0y} * t}_{\text{displacement (change in position)}})\,\vec{j} \ \ (m)$$

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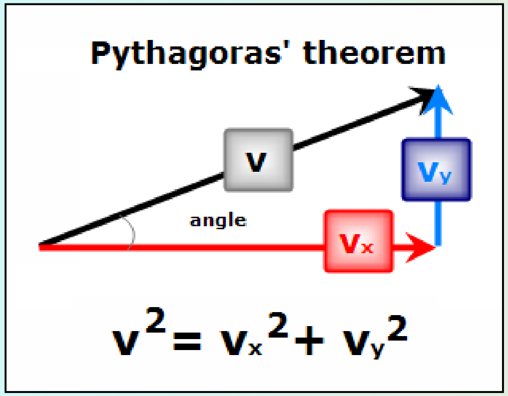
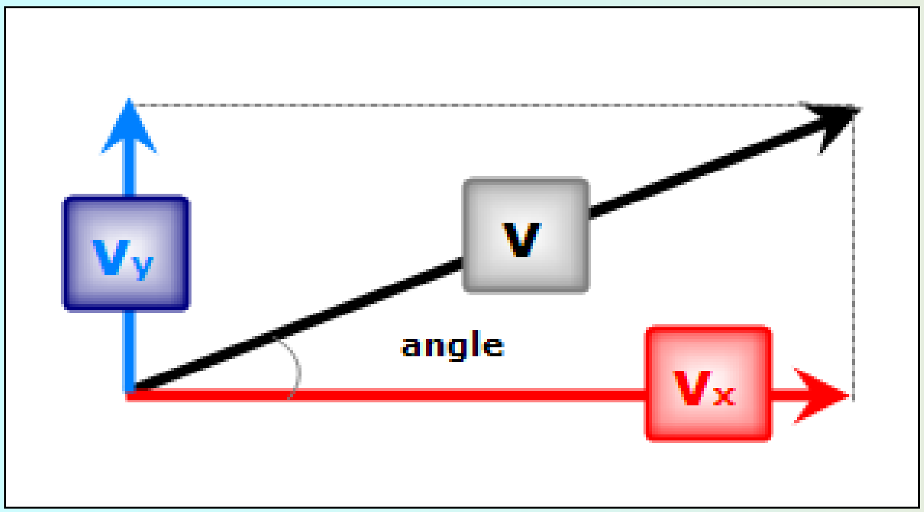
In a right angled triangle the square of the hypotenuse is equal to the sum of the squares of the other two sides





The magnitude of the velocity is given by:

$$|v| = \sqrt{v_x^2 + v_y^2}$$

The direction of velocity with respect to the X axis is given by the angle:

$$\text{Angle: } \alpha = \tan^{-1} \frac{v_y}{v_x} \;;$$

$$\alpha = \sin^{-1} \frac{v_y}{|v|} \;; \; \alpha = \cos^{-1} \frac{v_x}{|v|}$$

$$\text{Modulus: } |v| = \sqrt{v_x^2 + v_y^2}$$

$$\text{Angle: } \alpha = \tan^{-1} \frac{v_y}{v_x} \;; \; \alpha = \sin^{-1} \frac{v_y}{|v|} \;; \; \alpha = \cos^{-1} \frac{v_x}{|v|}$$

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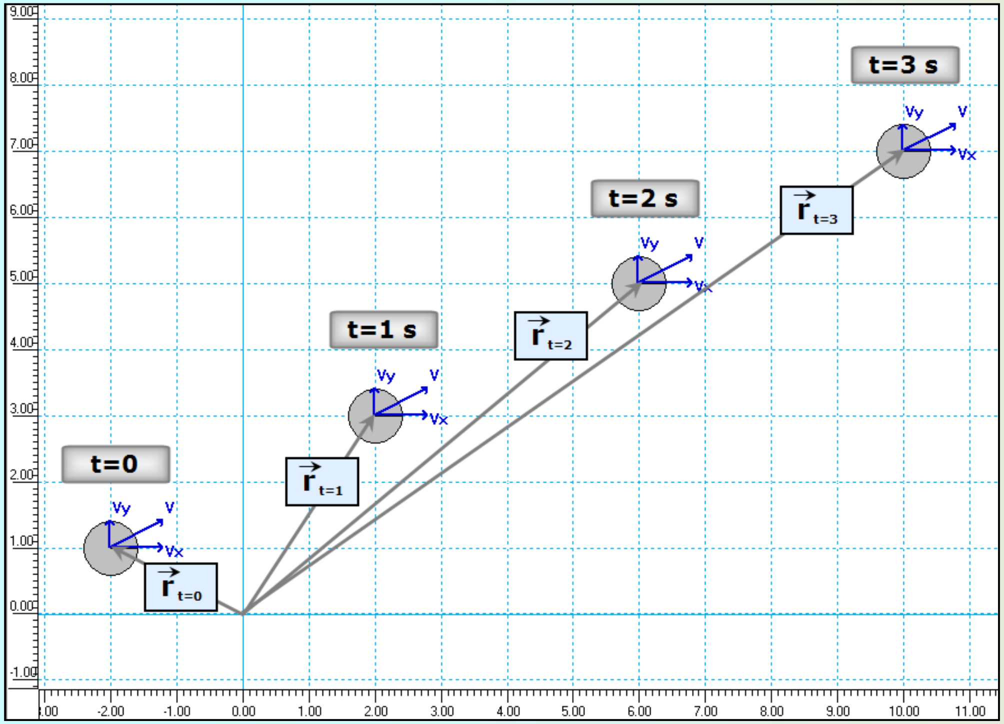

$$v_x = v_{0x} = \frac{\Delta x}{\Delta t} = +4\ \frac{m}{s}$$

$$v_y = v_{0y} = \frac{\Delta y}{\Delta t} = +2\ \frac{m}{s}$$

In our example, the magnitude of the velocity is:

$$|v| = \sqrt{v_x^2 + v_y^2} =$$

$$= \sqrt{\left(4\ \frac{m}{s}\right)^2 + \left(2\ \frac{m}{s}\right)^2} = 4.47\ \frac{m}{s}$$

And the direction with respect to X axis:

$$\alpha = \tan^{-1}\frac{2}{4} = 26.6\ ^{o}$$