Section 1.3 **Vector functions.**

Definition. The curve of a type $x = x(t)$, $y = y(t)$ is called a **parametric curve** and the variable t is called a **parameter**.

Definition. Vector $\vec{r}(t) =< x(t), y(t) >= x(t)\vec{\imath} + y(t)\vec{\jmath}$ is called the **position vector** for the point with coordinates $(x(t), y(t))$.

A function such as $\vec{r}(t)$, whose range is a set of vectors, is called a **vector function** of t.

Example 1.

(a.) Sketch the curve represented by the parametric equation $x(t) = \dfrac{1-t}{1+t}$, $y = t^2$.

(b.) Eliminate the parameter to find the Cartesian equation of the curve.

Example 2. An object is moving in the xy-plane and its position after t seconds is $\vec{r}(t) =< t-3, t^2-2t >$.

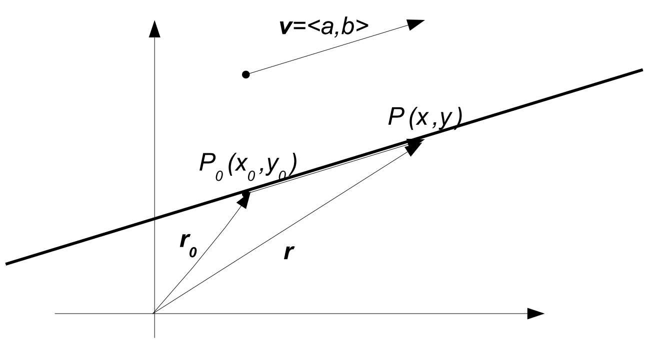
(a.) Find the position of the object at time $t = 5$.

(b.) At what time is the object at the point (1,8).

(c.) Does the object pass through the point (3,20).

(d.) Find an equation in x and y whose graph is the path of the object.

A line L is determined by a point P_0 on L and a direction. Let $\vec{v}$ be a vector parallel to line L. Let P be be an arbitrary point on L and let $\vec{r_0}$ and $\vec{r}$ be the position vectors of P and P_0.



Then the *vector equation* of line L is

$$\vec{r}(t) = \vec{r_0} + t\vec{v}$$

If $\vec{r} = < x(t), y(t) >$, $\vec{v} = < a, b >$ and $P(x_0, y_0)$ then *parametric equations* of the line L are

$$x(t) = x_0 + at, \qquad y(t) = y_0 + bt$$

Example 3. Find a vector, parametric, and Cartesian equations for the line containing the point (2,-1) and parallel to $2\vec{\imath} + 3\vec{\jmath}$.

Example 4. Find a vector and parametric equations for the line passing through the points $A(1, 3)$ and $B(2, -1)$.