

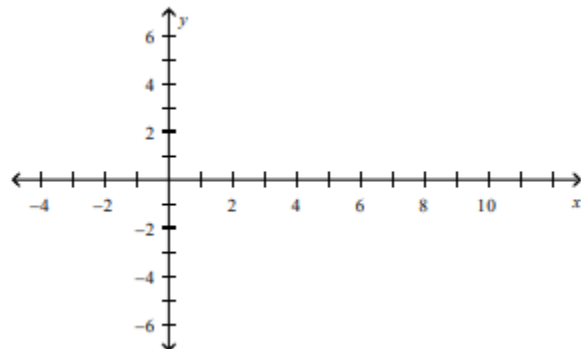
Think of a point moving in a plane through time. The x - and y - coordinates of the point will then be a function of time.

Let $x = f(t)$ and $y = g(t)$ where f and g are two functions whose common domain is some interval I . The collection of points defined by $(x, y) = (f(t), g(t))$ is called a **plane curve**. The equations $x = f(t)$ and $y = g(t)$, where t is in I , are **parametric equations** for the curve. the variable t is called **parameter**.

I. Graphing a Parametric Curve

Notice that for every value of t , we get a point on the curve.

$$\begin{aligned}x &= 3t^2 & y &= 2t \\ -2 &\leq t \leq 2\end{aligned}$$



Now find the rectangular equation for the parametric curve.

II. Eliminating the Parameter

Often a curve given by parametric equations can also be represented by a single rectangular equation in x and y . The process of finding this equation is called eliminating the parameter.

1. Find the rectangular equation for the plane curve defined by the parametric equations. Determine the domain of x .

$$x = 4t \quad y = t - 3 \quad -2 \leq t \leq 2$$

2. Find the rectangular equation of the curve whose parametric equations are:

$$x = 4 \cos t \quad y = 3 \sin t \quad 0 \leq t \leq 2\pi$$

III. Application

In these types of problems x is distance (h), y is height (v) and t is time.

1. An object is thrown at an angle of 45° . Given the parameters, $x = 31.5t$ and $y = -16t^2 + 31.5t$, find the following.

- How high will the object be after 1 second?
- When does the object hit the ground?
- How far has the object traveled when it hits the ground?

2. A shirt is launched from a t-shirt cannon at a basketball game. The object's path can be modeled by the following parameters, $x = 27t$ and $y = -9t^2 + 108t$.

- How high is the object after 4 seconds?
- When does the shirt hit the ground?
- How far has the shirt traveled when it hits the ground?
- When is the shirt the highest in the air?

IV. Projectile Motion

$$x = (v_0 \cos \theta)t$$

$$y = -\frac{1}{2}gt^2 + (v_0 \sin \theta)t + h$$

where $v_0 \rightarrow$ initial velocity

$h \rightarrow$ initial height

$g \rightarrow$ gravity

1. An object is thrown with an initial velocity of 170 ft/sec at an angle of 30° .

- Write the parametric equations.
- How long is it in the air?
- What is the maximum height?
- What is the distance traveled?

2. An object is thrown with an initial velocity of 50 ft/sec at a height of 6 ft, straight up.

- Write the parametric equations.
- How long is it in the air?
- What is the maximum height?