

# More Conics

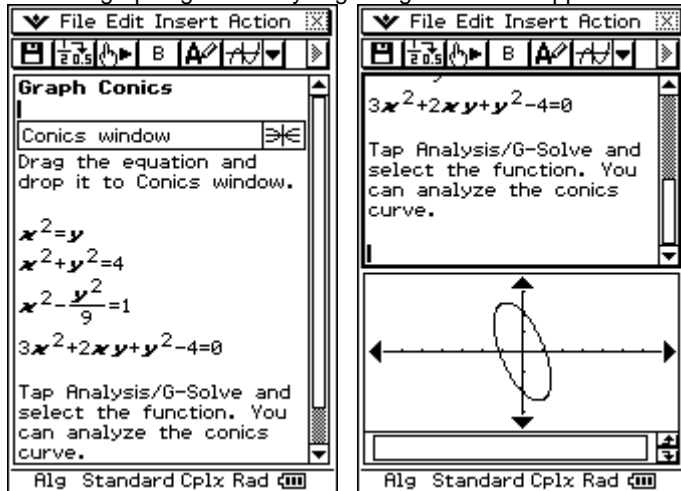
This week, we continue our exploration of conics using the ClassPad's Conics application. We will go from simple graphing to plotting each planet's orbit in our solar system. Learn how to move the conic equation you are graphing. Calculate the eccentricity of each equation.

This file includes eActivities on:

- 1 **Graph conics** – Practice graphing and analyzing using the Conics application.
- 2 **Discriminant** – Identify an ellipse, parabola or hyperbola using the discriminant.
- 3 **Translation** – Watch the ellipse shift around the graph. Easily, set your equation into Standard Form.
- 4 **Conics-Parametric** – Compare the graphs of conics equations in parametric form.
- 5 **Rotation of Axes** – Rotation of axes using a transformation matrix.
- 6 **Rotation of Graph** - Two examples on how to rotate the graph.
- 7 **Eccentricity e** – Do you know how to find the eccentricity of each conics equation?
- 8 **Eccentricity Graph** – Change the numbers and change the graph's position and shape.
- 9 **Planetary Orbit** - Graph the orbits of all our planets.

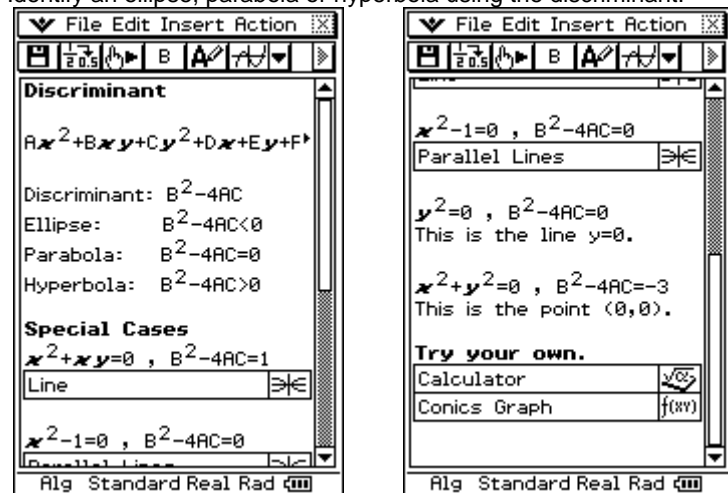
## 1 Graph conics

Practice graphing and analyzing using the Conics application.



## 2 Discriminant

Identify an ellipse, parabola or hyperbola using the discriminant.



### 3\_Translation

Watch the ellipse shift around the graph. Easily, set your equation into Standard Form.

File Edit Insert Action

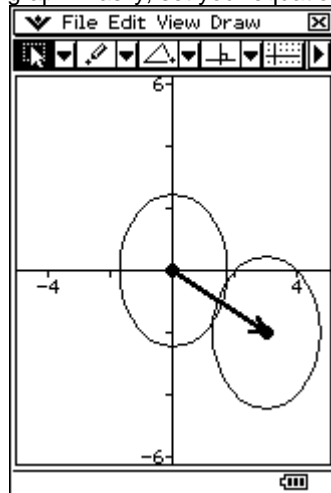
**Translation**

<Example>  
Equation(1)  
 $\frac{x^2}{3} + \frac{y^2}{6} = 1$   
Center is  $\begin{bmatrix} 0 \\ 0 \end{bmatrix}$

Graph of equation(1)

Equation(2)  
 $\frac{(x-3)^2}{3} + \frac{(y+2)^2}{6} = 1$   
Center is  $\begin{bmatrix} 3 \\ -2 \end{bmatrix}$

Alg Standard Real Rad



File Edit Insert Action

<Standard Form>  
When you have the equation like below  
 $6x^2 + 3y^2 - 36x + 12y + 48 = 0$ ,  
copy the equation to Conics Equation window.

Conics Equation  $f(x,y)$

Tap "Fit into Conics Form".  
You find the standard form.  
 $\frac{(x-3)^2}{3} + \frac{(y+2)^2}{6} = 1$

Try your own.  
Geometry

Alg Standard Real Rad

### 4 Conics-Parametric

Compare the graphs of conics equations in parametric form.

File Edit Insert Action

**Conics (PE)**  
Parametric Equations

<Circle>  
 $(x-H)^2 + (y-K)^2 = R^2$   
Try it!  $f(x,y)$

$x = a \cdot \cos(t) + c$   
 $y = a \cdot \sin(t) + d$   
Try it!  $\begin{matrix} Y1: \\ Y2: \end{matrix}$

<Ellipse>  
 $\frac{(x-H)^2}{A^2} + \frac{(y-K)^2}{B^2} = 1$   
Try it!  $f(x,y)$

Alg Standard Cplx Rad

File Edit Insert Action

<Hyperbola>  
 $\frac{(x-H)^2}{A^2} - \frac{(y-K)^2}{B^2} = 1$   
Try it!  $f(x,y)$

$x = a \cdot \frac{1}{\cos(t)} + c$   
 $y = b \cdot \tan(t) + d$   
Try it!  $\begin{matrix} Y1: \\ Y2: \end{matrix}$

$\frac{(y-K)^2}{A^2} - \frac{(x-H)^2}{B^2} = 1$   
Try it!  $f(x,y)$

Alg Standard Cplx Rad

### 5\_Rotation of Axes

Rotation of axes using a transformation matrix.

File Edit Insert Action

**Rotation of Axes**

Rotate  $xy$  coordinate to  $uv$  coordinate

$$\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} \cos(\theta) & -\sin(\theta) \\ \sin(\theta) & \cos(\theta) \end{bmatrix} \begin{bmatrix} u \\ v \end{bmatrix}$$

<Example>  
Find the equation for  $x^2 - 2y = 0$ , if  $xy$  axes are rotated by  $\frac{\pi}{4}$ .

Graph  $x^2 - 2y = 0$

Here is the transformation matrix.

Alg Standard Real Rad

File Edit Insert Action

Here is the transformation matrix.

Calculator  $\sqrt{\cos}$

$$\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} \frac{\sqrt{2} \cdot u - \sqrt{2} \cdot v}{2} \\ \frac{\sqrt{2} \cdot u + \sqrt{2} \cdot v}{2} \end{bmatrix}$$

$\begin{bmatrix} \cos(\theta) & -\sin(\theta) \\ \sin(\theta) & \cos(\theta) \end{bmatrix} \begin{bmatrix} u \\ v \end{bmatrix} \mid \theta = \frac{\pi}{4}$

$$\begin{bmatrix} \frac{\sqrt{2} \cdot u - \sqrt{2} \cdot v}{2} \\ \frac{\sqrt{2} \cdot u + \sqrt{2} \cdot v}{2} \end{bmatrix}$$

Alg Standard Real Rad

## 6\_Rotation of Graph

Two examples on how to rotate the graph.

**Rotation of Graph**

**<Example-1>**  
 You have the equation.  
 $\frac{x^2}{2} + \frac{y^2}{6} = 1$ , Center  $\begin{bmatrix} 0 \\ 0 \end{bmatrix}$

Geometry window

In Geometry, rotate the graph 45° around the center.

Rotation

On the Geometry window, drag the new graph and drop it below.

Alg Standard Real Rad

**File Edit View Draw**

Alg

## 7\_Eccentricity e

Do you know how to find the eccentricity of each conics equation?

**Eccentricity e**

$e = \frac{\text{Distance (Foci)}}{\text{Distance (Vertices)}}$

**Ellipse**

$$e = \frac{c}{a} = \frac{\sqrt{a^2 - b^2}}{a}$$

**Hyperbola**

$$e = \frac{c}{a} = \frac{\sqrt{a^2 + b^2}}{a}$$

**Parabola e=1**

Alg Standard Cplx Rad

**File Edit Insert Action**

**<Example>**  
 Find the eccentricity for  
 $\frac{(y+1)^2}{5^2} + \frac{(x-3)^2}{4^2} = 1$

Conics window

Alg Standard Cplx Rad

## 8\_Eccentricity Graph

Change the numbers and change the graph's position and shape.

**Eccentricity Conics Graph (Polar)**

$$r = \frac{de}{1 \pm e \cdot \cos(\theta)}$$

or

$$r = \frac{de}{1 \pm e \cdot \sin(\theta)}$$

e: Eccentricity  
 d: Directrix x=d  
 Ellipse:  $0 < e < 1$   
 Parabola:  $e = 1$   
 Hyperbola:  $1 < e$

**<Example>**  
 Change the number for d,  
 e, and the FVF, then open

Alg Standard Cplx Rad

**Edit Zoom Analysis**

Rad Cplx

## 9\_Planetary Orbit

Graph the orbits of all our planets.

File Edit Insert Action

Planetary Orbit

$$r = \frac{a \cdot (1 - e^2)}{1 + e \cdot \cos(\theta)}$$

a: Semimajor Axes  
e: Eccentricity

**Axes & e of Planets**

	Axis (Gm)	e
Mercury	57.9	0.205
Venus	108.2	6.8E-
Earth	149.6	0.016
Mars	227.9	0.093
Jupiter	778.3	0.048
Saturn	1427	0.056
Uranus	2869	0.046

Alg Standard Cplx Rad

Edit Type GMem

Sheet1 Sheet2 Sheet3

$r_1 = \frac{55.45248826}{0.2056 \cdot \cos(\theta)}$

$r_2 = \frac{108.1949968}{6.8E-3 \cdot \cos(\theta)}$

$r_3 = \frac{149.5582781}{0.0167 \cdot \cos(\theta)}$

$r_4 = \frac{225.9119007}{0.0934 \cdot \cos(\theta)}$

$r_5 = \frac{776.469243E}{0.0485 \cdot \cos(\theta)}$

$r_6 = \frac{1422.524928}{0.056 \cdot \cos(\theta) + 2862.90277E}$

$r_7 = \frac{0.0461 \cdot \cos(\theta)}{4496.887575}$

$r_8 = \frac{5E-3 \cdot \cos(\theta) + 1}{}$

Rad Cplx

